Unit 8
Linear Graphs & Their Application

EXERCISE 8.1

Q1. Determine the quadrant of the coordinate plane in which the following points lie:
$P(-4,3), Q(-5,-2), R(2,2)$ and $S(2,-6)$.

Solution:

$P(-4,3)$ lies in Second quadrant.
$Q(-5,-2)$ lies in Third quadrant.
$R(2,2)$ lies in First quadrant.
$S(2,-6)$ lies in Fourth quadrant.

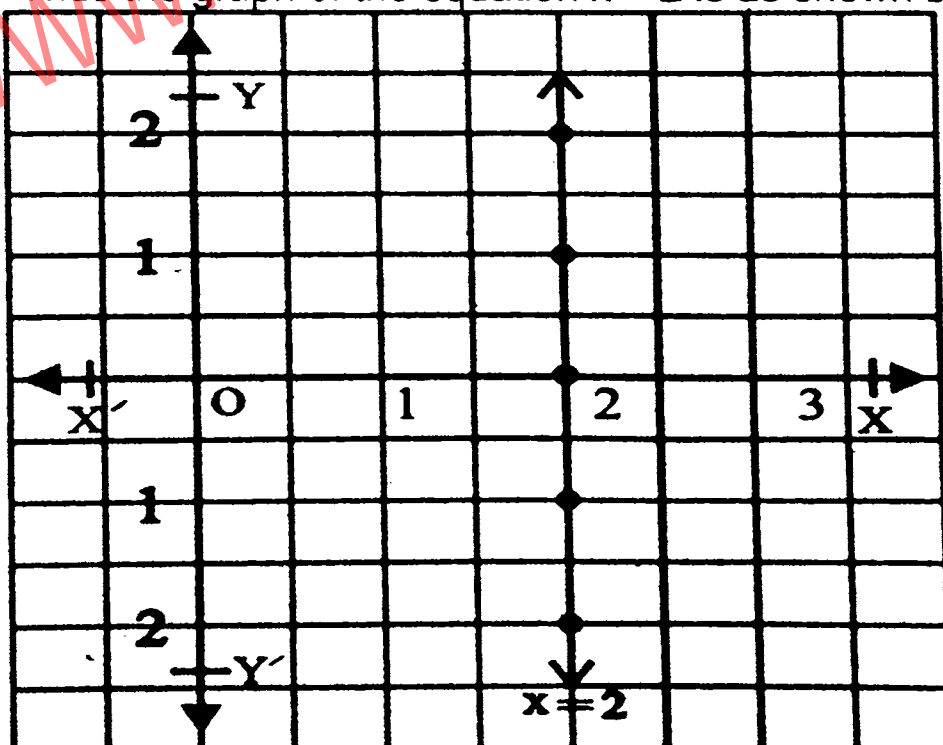
Q2. Draw the graph of each of the following.

(i) $x = 2$

Solution:

Table for the points of the equation x = 2 is as under:

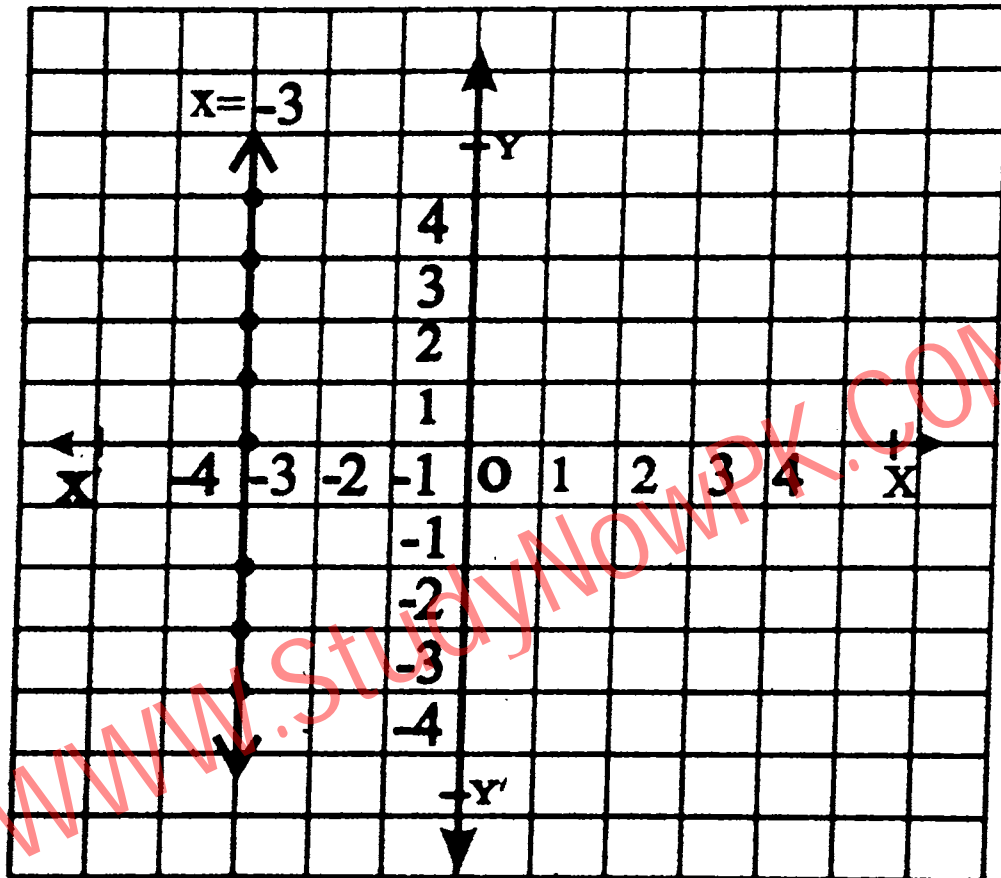
x	2	2	2	2	2	2	2
y	...	−2	−1	0	1	2	...

Thus the graph of the equation x = 2 is as shown below.

(ii) $x = -3$

Solution:

Table for the points of the equation $x = -3$ is as under:

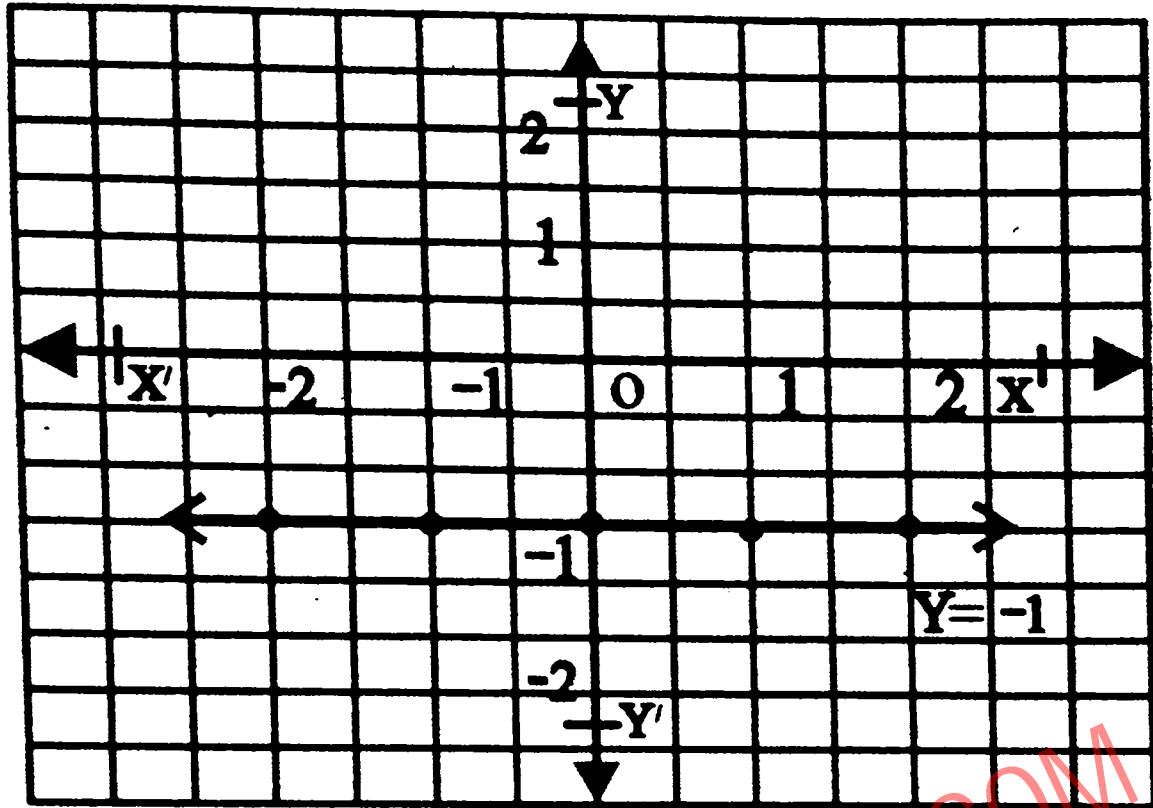
x	-3	-3	-3	-3	-3	-3	-3
y	...	-2	-1	0	1	2	...

Thus the graph of the equation $x = -3$ is as shown below.

(iii) $y = -1$

Solution:

Table for the points of the equation $y = -1$ is as under:

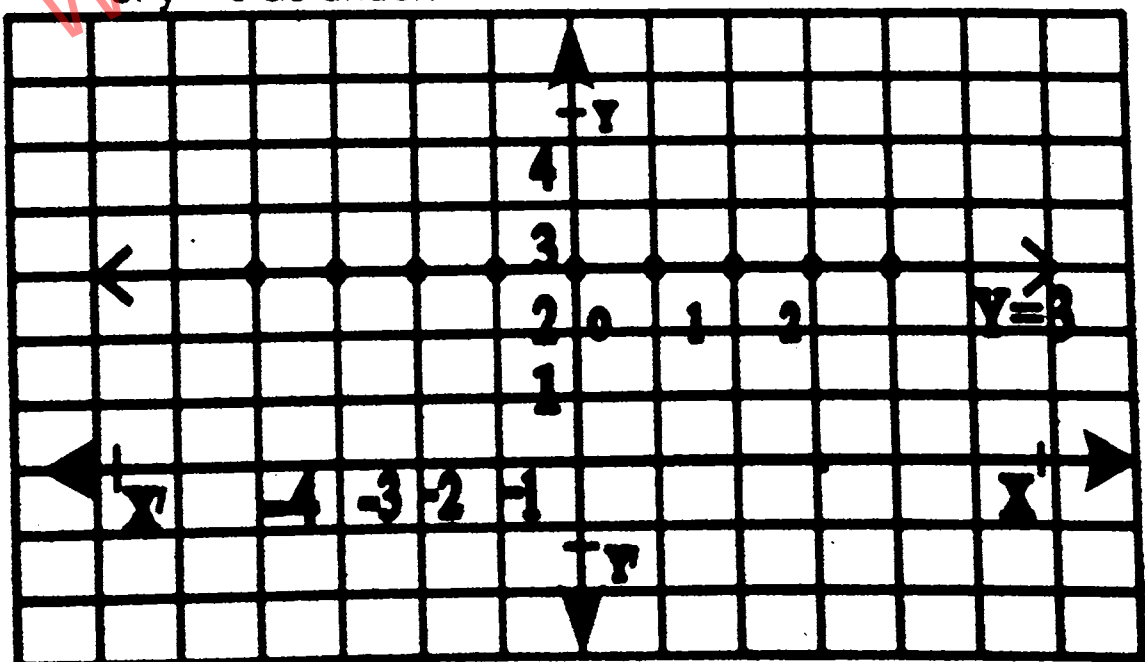
x	...	-2	-1	0	1	2	...
y	-1	-1	-1	-1	-1	-1	-1

Plotting these points and joined them we get the graph of $y = -1$ as under:

(iv) $y = 3$

Solution:

Table for the points of the equation y = 3 is as under:

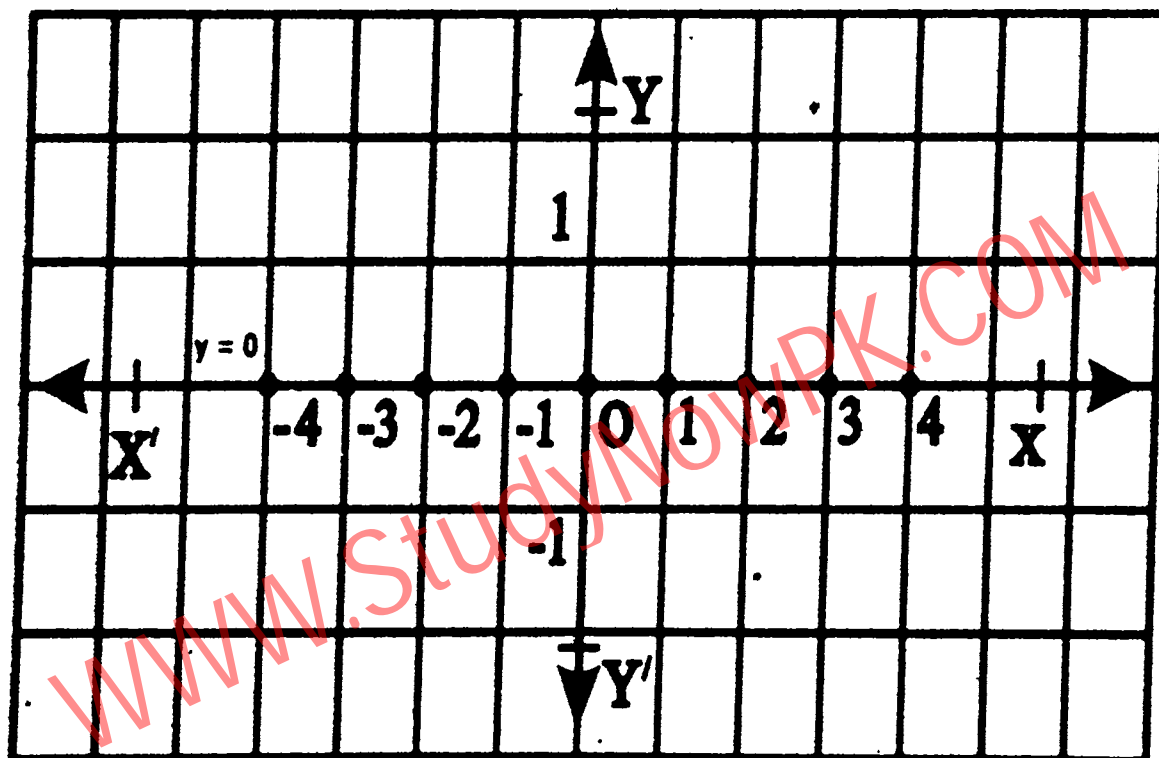
x	...	−2	−1	0	1	2	...
y	3	3	3	3	3	3	3

Plotting these points and joined them we get the graph of y = 3 as under:

(v) $y = 0$

Solution:

Table for the points of the equation y = 0 is as under:

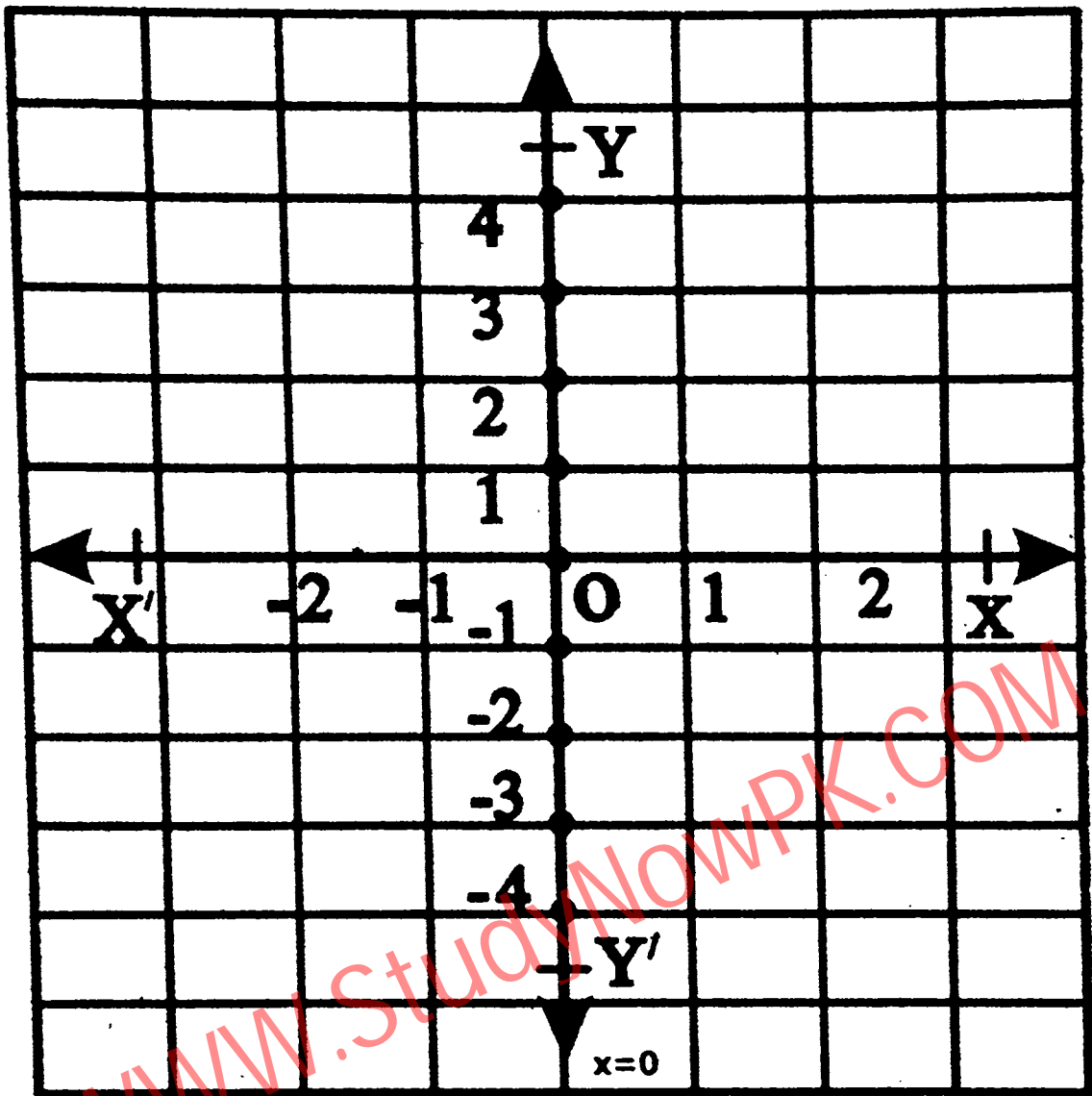
x	...	−2	−1	0	1	2	...
y	0	0	0	0	0	0	0

Plotting these points we see that all the points are on x-axis. So the graph of the equation y = 0 is x-axis as shown below.

vi) $x = 0$

Solution:

Table for the points of the equation x = 0 is as under:

x	0	0	0	0	0	0	0
y	...	−2	−1	0	1	2	...

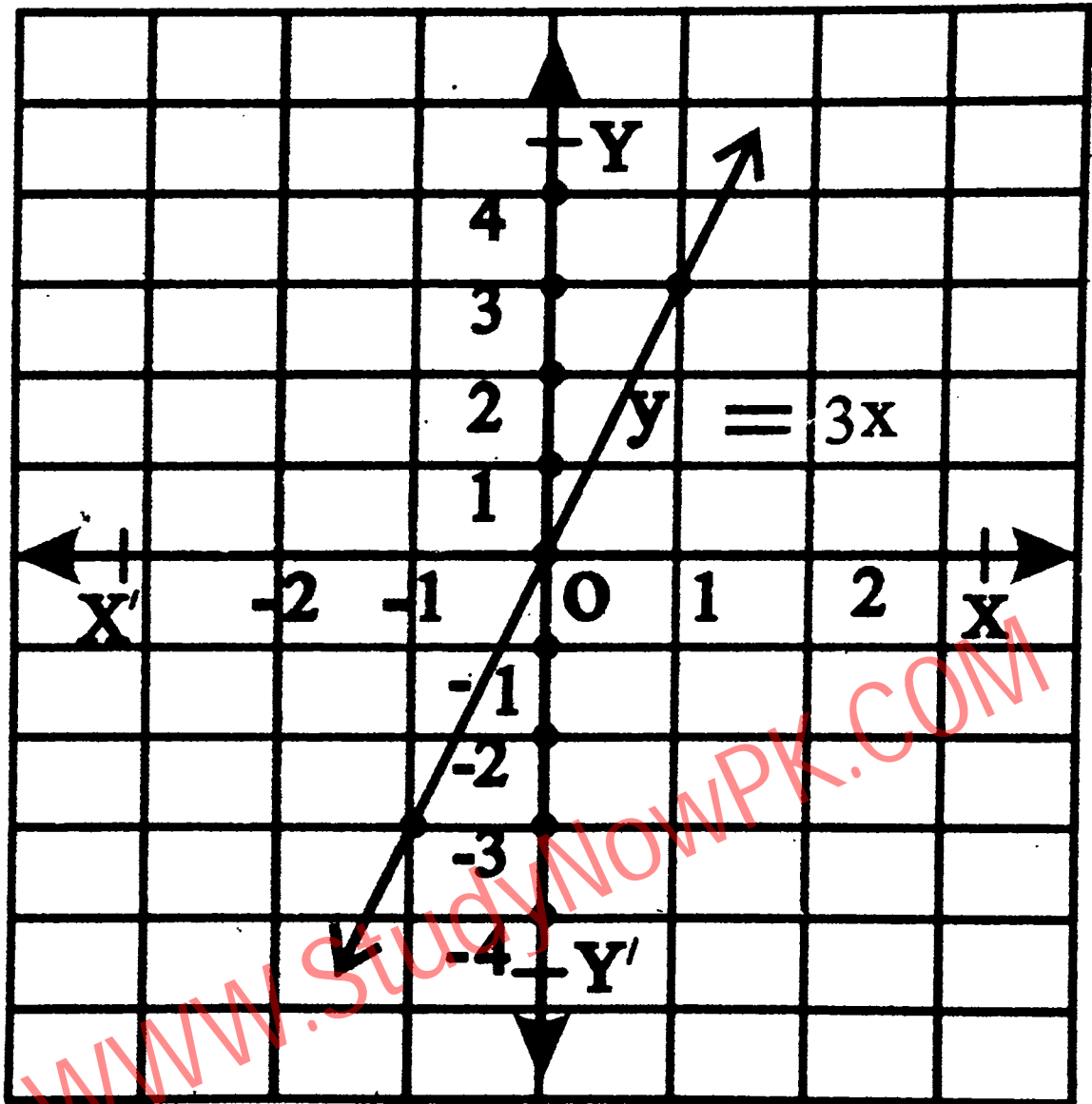
Plotting these points we see that all the points are on y-axis. So the graph of the equation x = 0 is y-axis as shown below.

(vii) $y = 3x$

Solution:

Table for the points of the equation y = 3x is as under:

x	– 2	– 1	0	1	2
y	– 6	–3	0	3	6

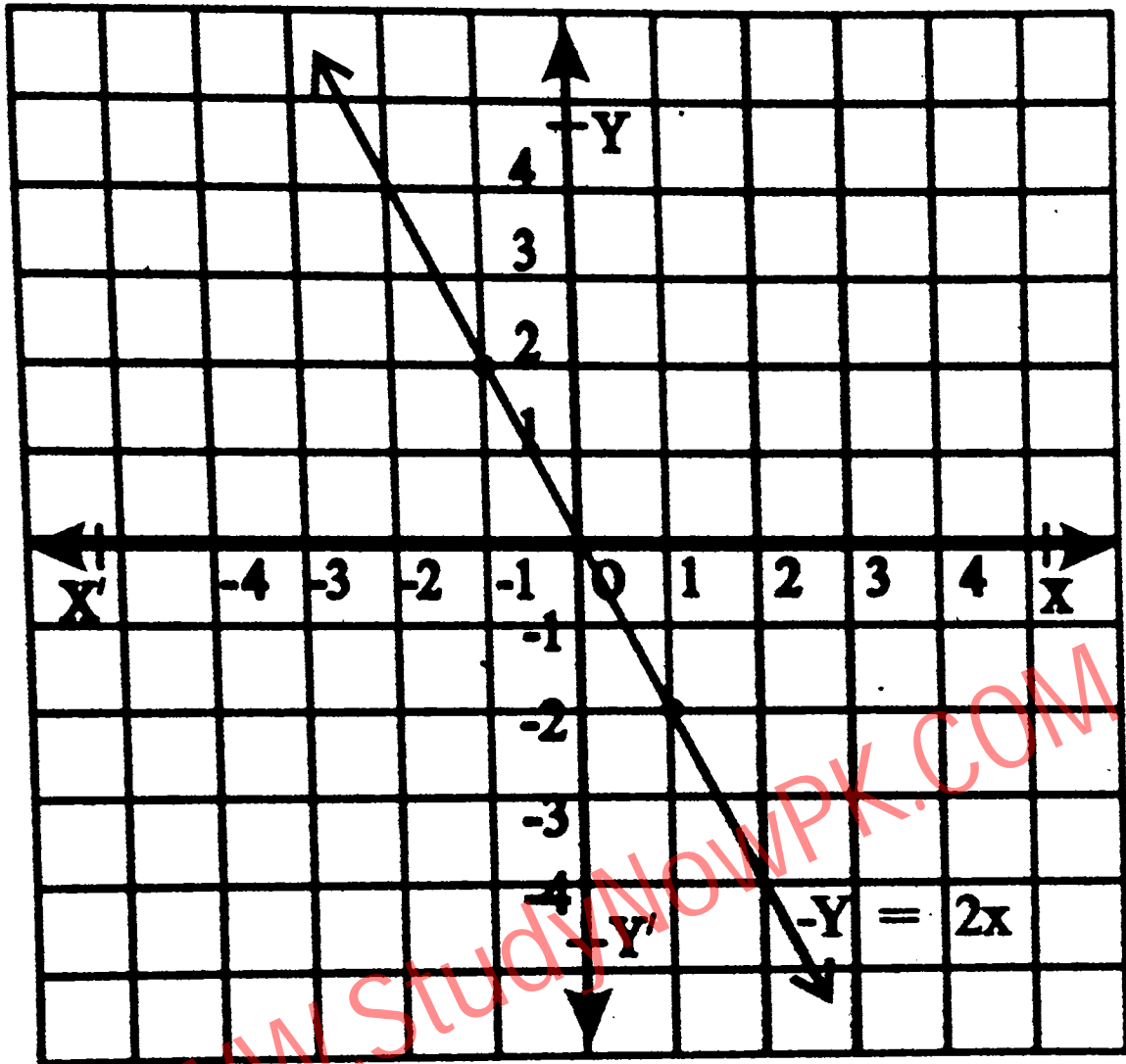
The points (x, y) are plotted in the plane as shown below:

Joining them we get the graph of the line y = 3x as under:

(viii) $-y = 2x$ or $y = -2x$

Solution:

Table for the points of the equation $y = -2x$ or $-y = 2x$ is as under:

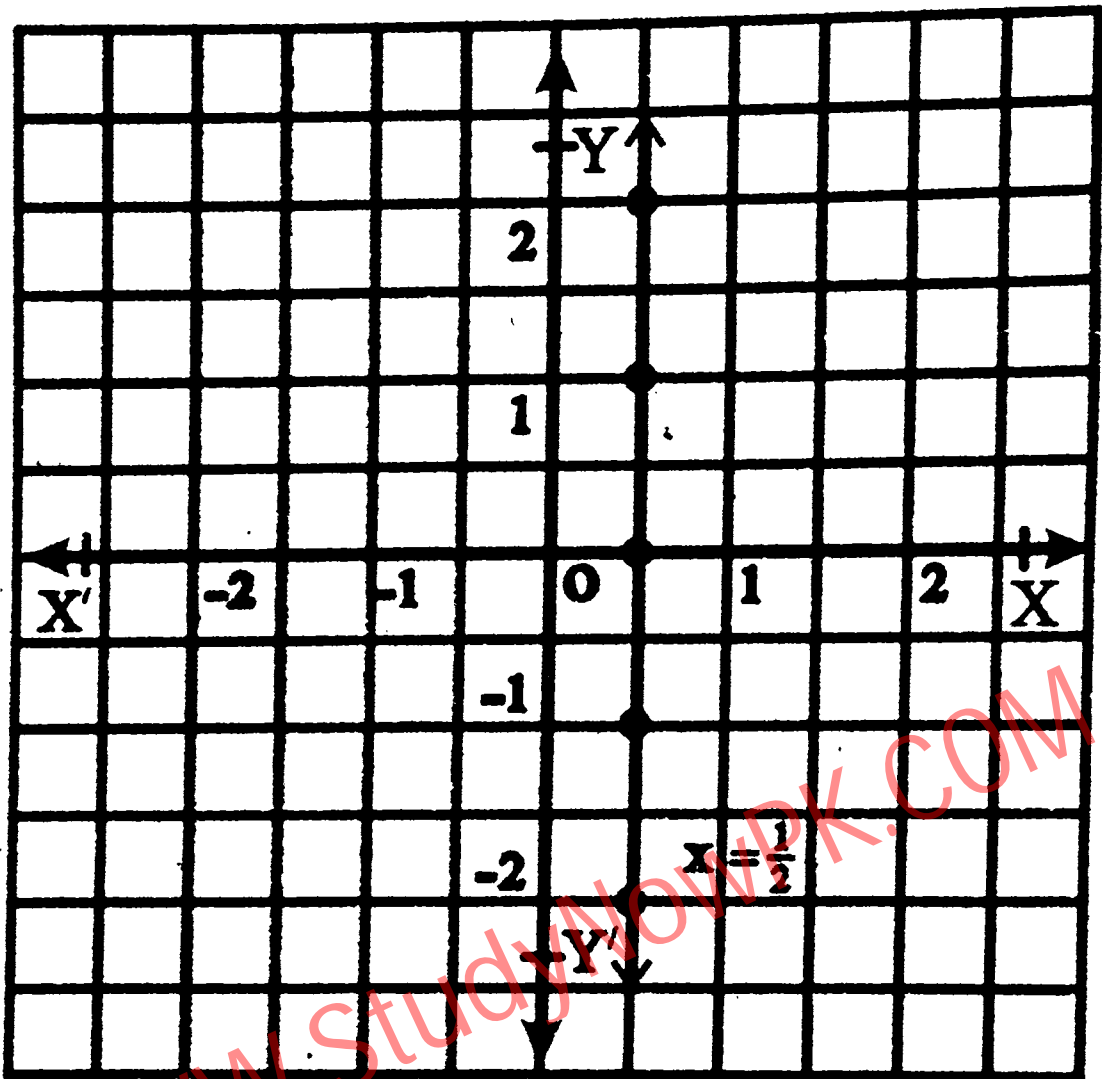
x	-2	-1	0	1	2
y	4	2	0	-2	-4

The points are plotted in the plane as under. By joining the plotted points we get the graph of the equation $-y = 2x$ as under:

(ix) $\frac{1}{2} = x$ or $x = 0.5$

Solution:

Table for the points of the equation $x = \frac{1}{2} = 0.5$ is as under:

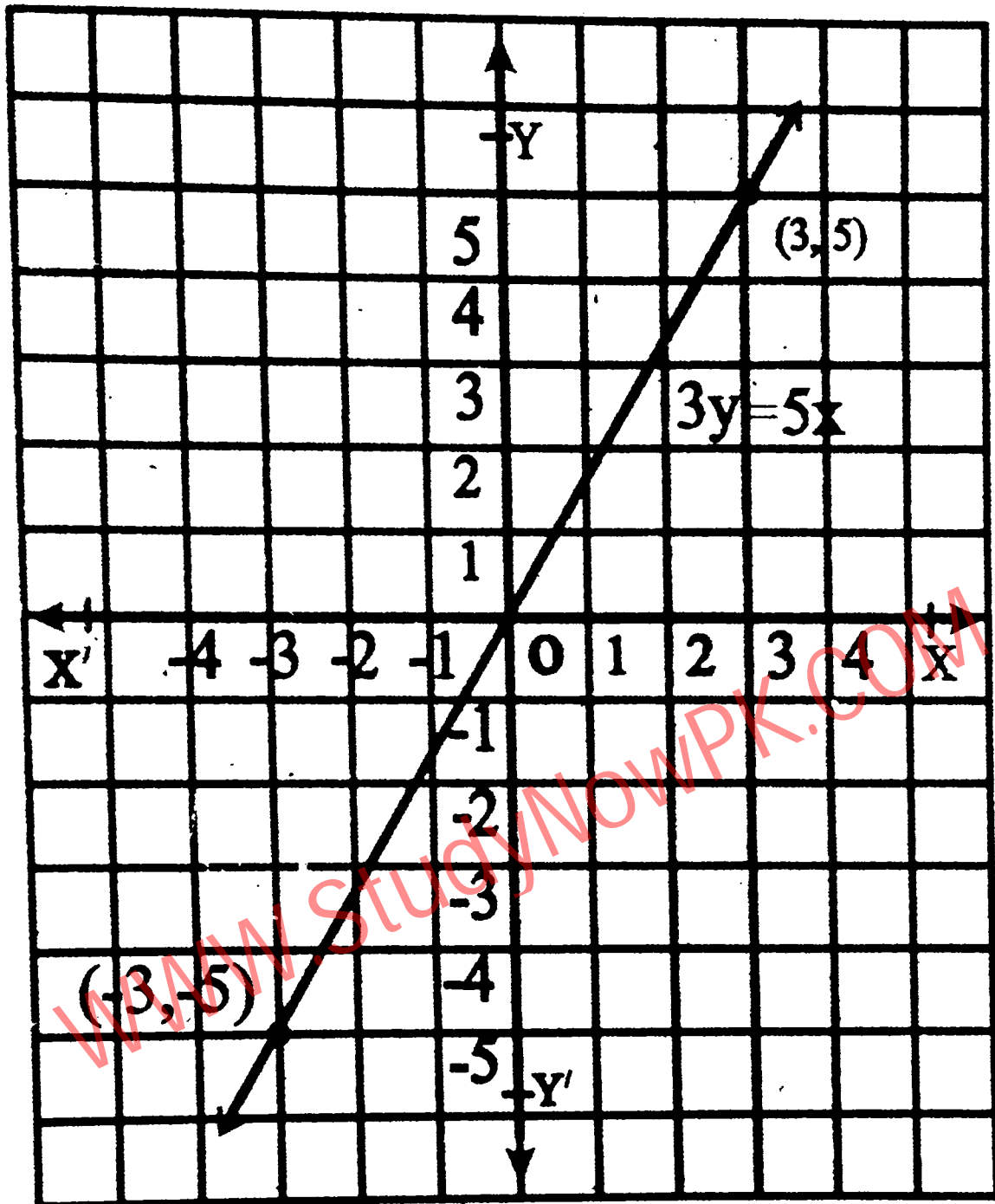
x	0.5	0.5	0.5	0.5	0.5
y	−2	−1	0	1	2

The points are plotted in the plane as below. Joining them we get the graph of the equation $\frac{1}{2} = x$ as under.

(x) $3y = 5x$ or $y = \frac{5}{3}x$

Solution:

Table for the points of the equation $3y = 5x$ or $y = \frac{5}{3}x$ is as under:

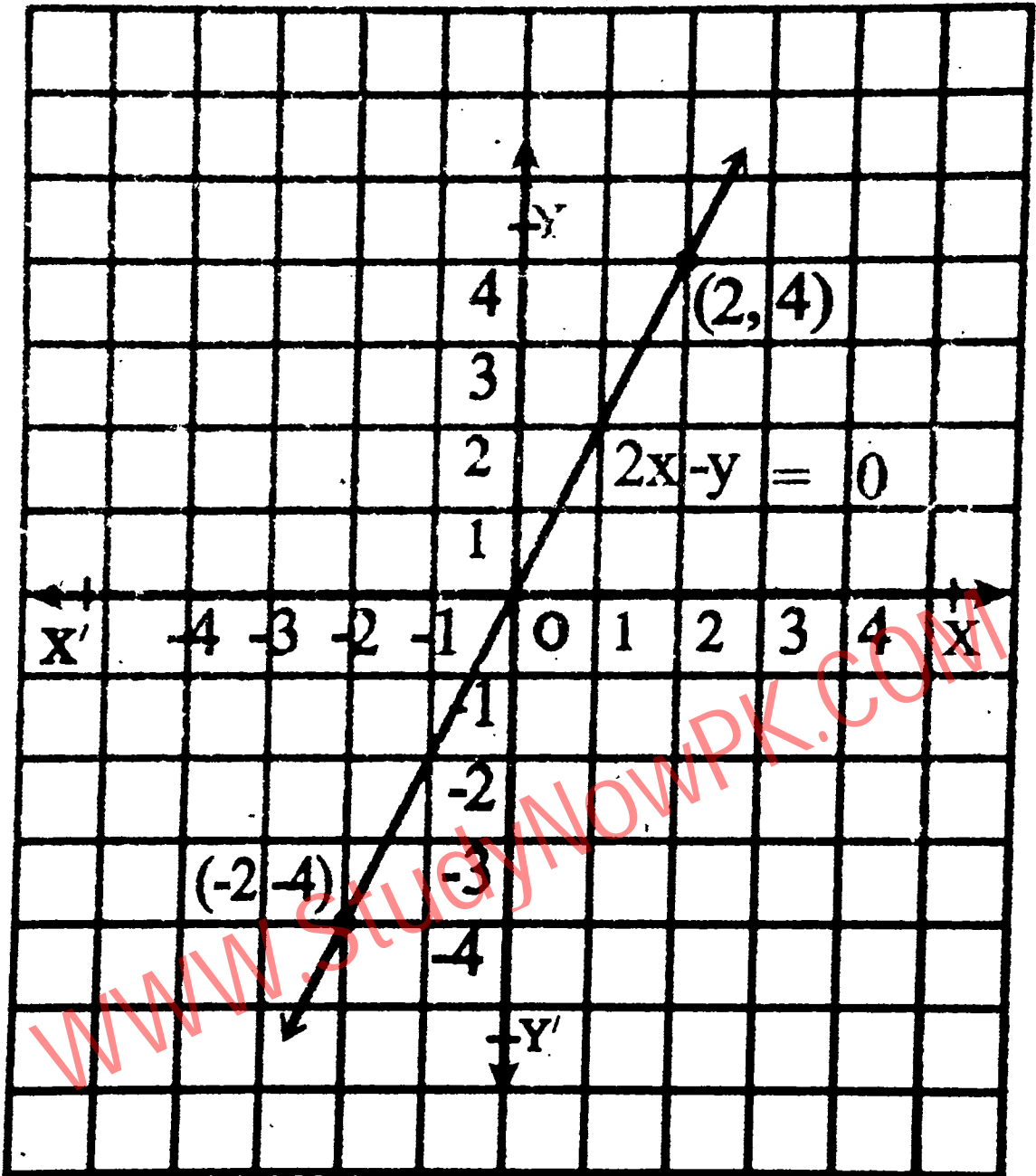
x	−6	−5	−4	−3	−2
y	−10	−8.3	−6.7	−5	−3.3
x	−1	0	−1	−2	−3
y	−1.7	0	−1.7	−3.3	−5

The points are plotted in the plane as under. By joining the plotted points we get the graph of the equation $3y = 5x$ as under:

(xi) $2x - y = 0$ or $y = 2x$

Solution:

Table for the points of the equation is as under:

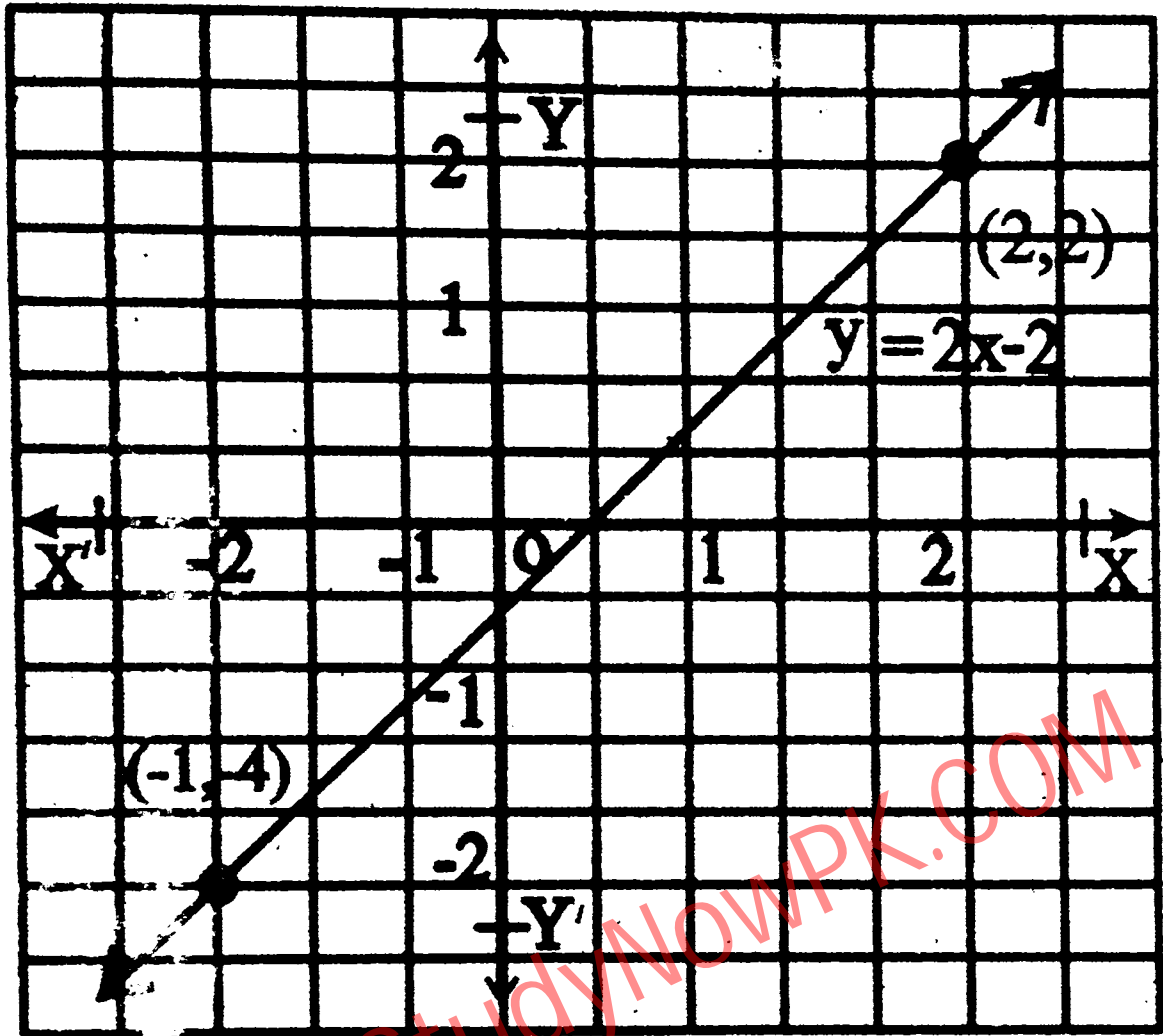
x	-2	-1	0	1	2
y	-4	-2	0	2	4

The points are plotted in the plane as under. By joining the plotted points we get the graph of the equation as under:

(xii) $2x - y = 2$ or $y = 2x - 2$

Solution:

Table for the points of the equation is as under:

x	-2	-1	0	1	2
y	-6	-4	-2	2	4

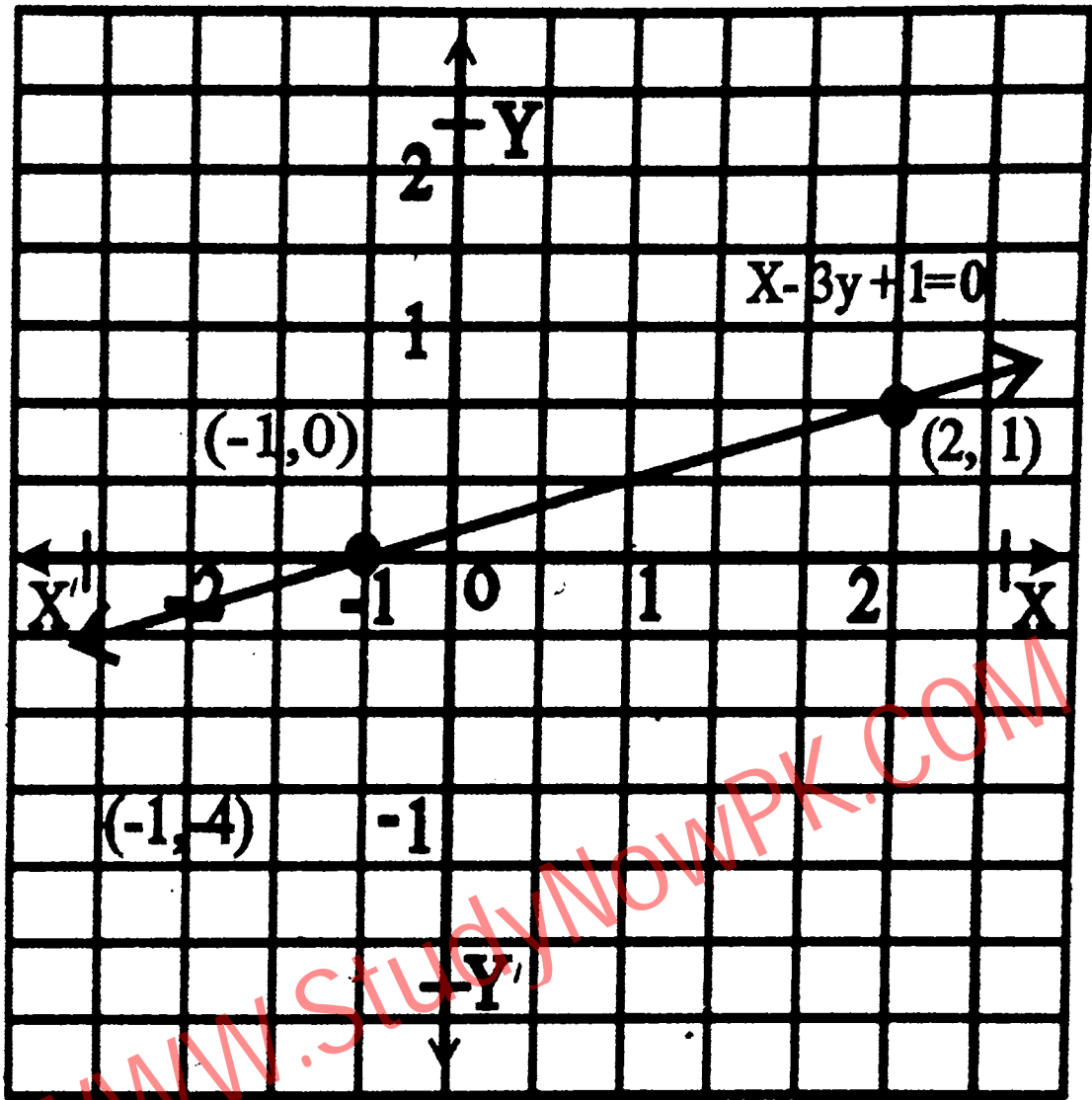
The points are plotted in the plane as under by joining the plotted points we get the graph of the equation as under:

(xiii) $x - 3y + 1 = 0$

Solution:

i.e. $x = 3y - 1$ or $y = \frac{x+1}{3}$

Table for the points of equation is as under:

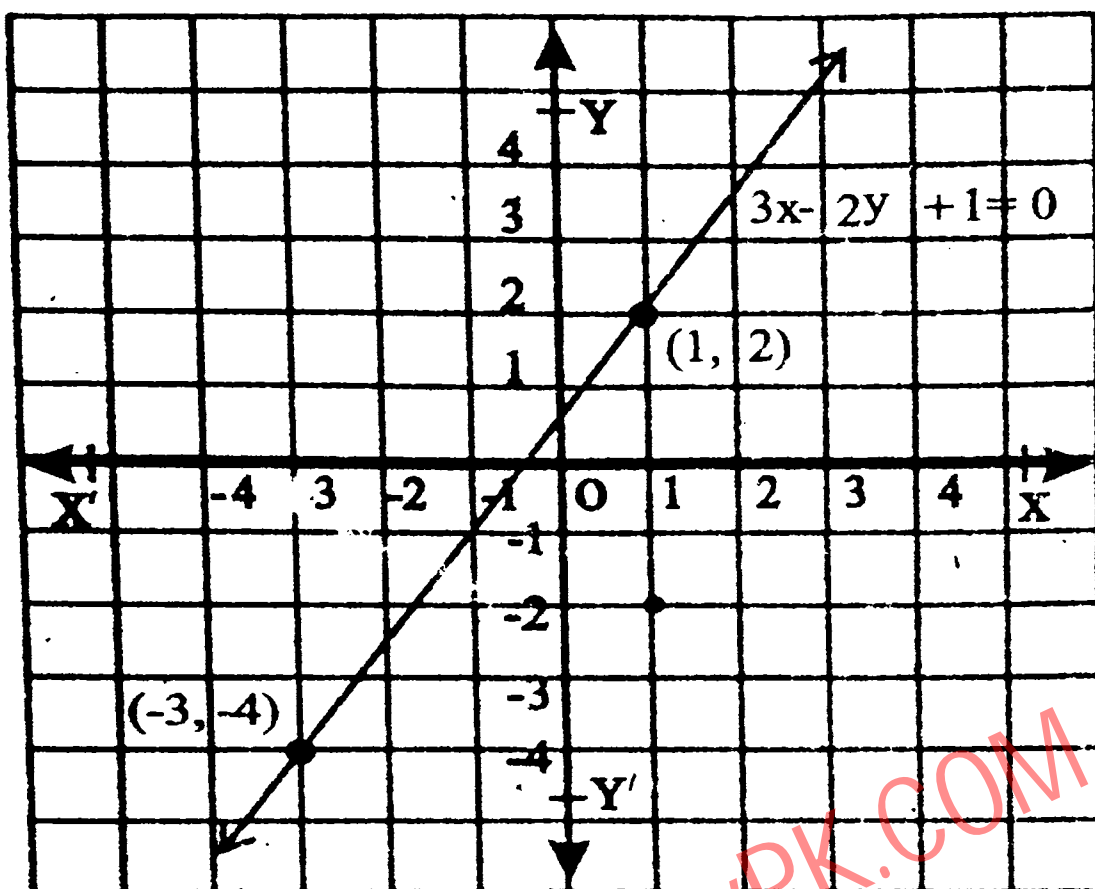
x	−2	−1	0	1	2
y	−4	−2	0	2	4

The points are plotted in the plane. By joining the plotted points we get the graph of the equation as under:

(xiv) $3x - 2y + 1 = 0$ or $y = \frac{3x+1}{2}$

Solution:

Table for the points of the equation is as under:

x	-3	-2	-1	0	1
y	-4	$-2\frac{1}{2}$	-1	5	2

The points are plotted in the plane and by joining them we get the graph of the equation as under:

Q3. Are the following lines (i) parallel to x-axis (ii) parallel to y-axis.

(i) $2x - 1 = 3$ **(ii)** $x + 2 = -1$

(iii) $2y + 3 = 2$ **(iv)** $x + y = 0$

(v) $2x - 2y = 0$

(i) $2x - 1 = 3$

Solution:

$2x = 3 + 1 = 4$ or $x = 2$

is a line parallel to y-axis.

(ii) $x + 2 = -1$

Solution:

$x = -1 - 2$ or $x = -3$

is a line parallel to y-axis.

(iii) $2y + 3 = 2$

Solution:

$2y = 2 - 3 = -1$ or $y = -\frac{1}{2}$

is a line parallel to x-axis.

(iv) $x + y = 0$

Solution:

$x = -y$

neither parallel to x-axis nor y-axis.

(v) $2x - 2y = 0$

Solution:

$2x = 2y$ or $x = y$

neither parallel to x-axis nor y-axis.

Q4. Find the value of m and c of the following lines by expressing them in the form $y = mx + c$.

(a) $2x + 3y - 1 = 0$ **(b)** $x - 2y = -2$

(c) $3x + y - 1 = 0$ **(d)** $2x - y = 7$

(e) $3 - 2x + y = 0$ **(f)** $2x = y + 3$

(a) $2x + 3y - 1 = 0$

Solution:

$3y = -2x + 1$ or $y = -\frac{2}{3}x + \frac{1}{3}$

Since $y = mx + c$

So $m = -\frac{2}{3}$ $c = \frac{1}{3}$

(b) $x - 2y = -2$

Solution:

$-2y = -x - 2$ or $y = \frac{1}{2}x + 1$

Since $y = mx + c$

So $m = \frac{1}{2}$, $c = 1$

(c) $3x + y - 1 = 0$

Solution:

$y = -3x + 1$

Since $y = mx + c$

So $m = -3$, $c = 1$

(d) $2x - y = 7$

Solution:

$-y = -2x + 7$ or $y = 2x - 7$

Since $y = mx + c$

So $m = 2$, $c = -7$

(e) $3 - 2x + y = 0$

Solution:

$y = 2x - 3$

Since $y = mx + c$

So $m = 2$, $c = -3$

(f) $2x = y + 3$

Solution:

$y = 2x - 3$

Since $y = mx + c$

So $m = 2, \quad c = -3$

Q5. Verify whether the following point lies on the line $2x - y + 1 = 0$ or not.

(i) $(2, 3)$ **(ii)** $(0, 0)$

(iii) $(-1, 1)$ **(iv)** $(2, 5)$

(v) $(5, 3)$

(i) $(2, 3)$

Solution:

The line is $2x - y + 1 = 0$ for the point $(2, 3)$

$2(2) - 3 + 1 = 4 - 3 + 1 = 2 \neq 0$

$\therefore$ point does not lie on the line

(ii) $(0, 0)$

Solution:

The line is $2x - y + 1$

For the point $(0, 0)$

$2(0) - 0 + 1 = 0 - 0 = 1 \neq 0$

$\therefore$ point does not lie on the line

(iii) $(-1, 1)$

Solution:

The line is $2x - y + 1 = 0$ for $(-1, 1)$

$2(-1) - 1 + 1 = -2 - 1 + 1 = -2 \neq 0$

$\therefore$ the point does not lie on the line

(iv) $(2, 5)$

Solution:

The line is $2x - y + 1 = 0$ for the point $(2, 5)$

$2(2) - 5 + 1 = 4 - 5 + 1 = 0$

$\therefore$ the point lies on the line

(v) $(5, 3)$

Solution:

The line is $2x - y + 1 = 0$ for the point $(5, 3)$

$2(5) - 3 + 1 = 10 - 3 + 1 = 8 \neq 0$

$\therefore$ the point does not lie on the line.

EXERCISE 8.2

Q1. Draw the conversion graph between litres and gallons using the relation 9 litres = 2 gallons (approximately), and taking litres along horizontal axis and gallons along vertical axis. From the graph, read

(i) the number of gallons in 18 litres

(ii) the number of litres in 8 gallons

Solution:

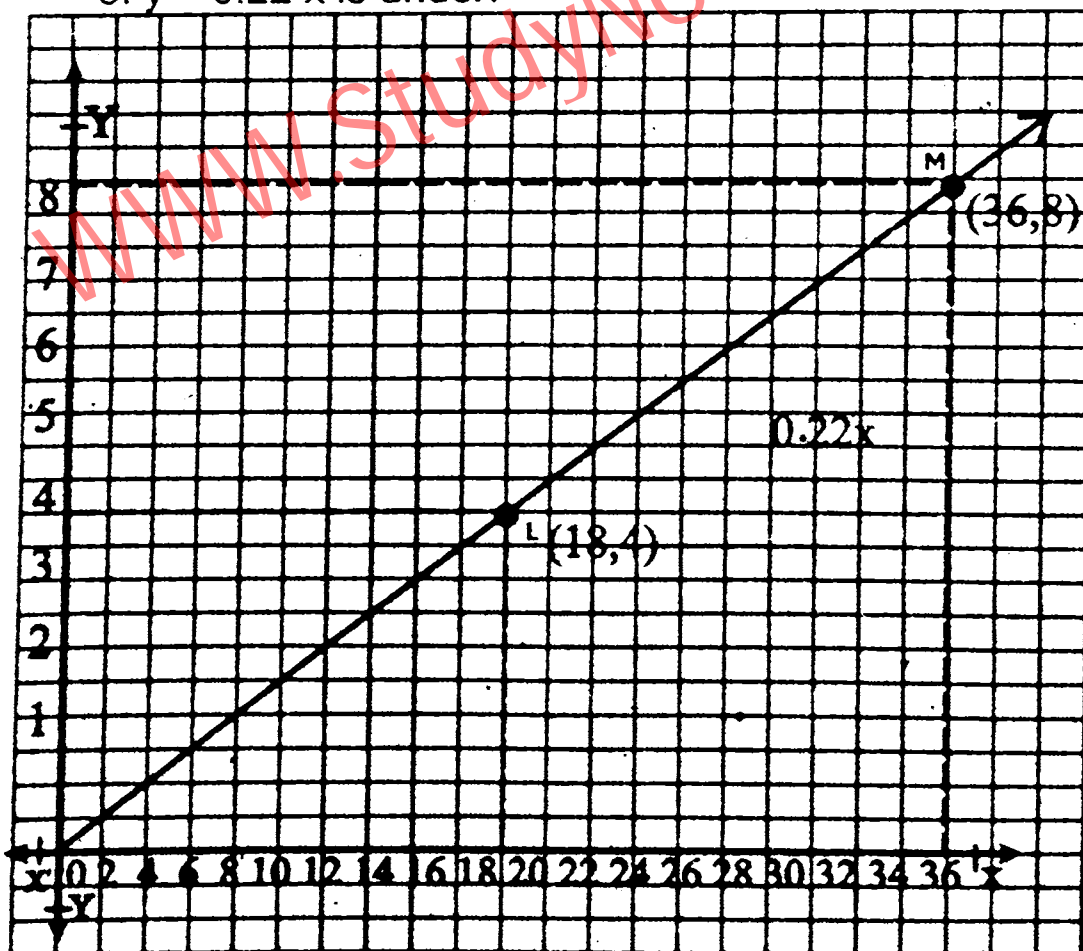
9 litres = 2 gallons

As liters are represented along horizontal axis and gallon along y-axis we have

$y = \frac{2}{9}x$ or $y = 0.22\,x$ (approx)

The table for values of x and y is

x	0	1	2	3	5
y	0	0.22	0.44	0.66	1.1

Plotting these points and joining them we get the graph of y = 0.22 x is under:

(i) To read the number of gallons in 18 litres. We draw the vertical line through point showing 18 litres. It meets the graph of $y = 0.22\,x$ at L. We read that L shows 4 gallons.

(ii) The number of litres in 8 gallons. We draw the horizontal line through the point showing 8 gallons. It meets the graph of $y = 0.22\,x$ at M. Against M we read 36 litres.

Q2. On 15.03.2008 the exchange rate of Pakistani currency and Saudi Riyal was as under:

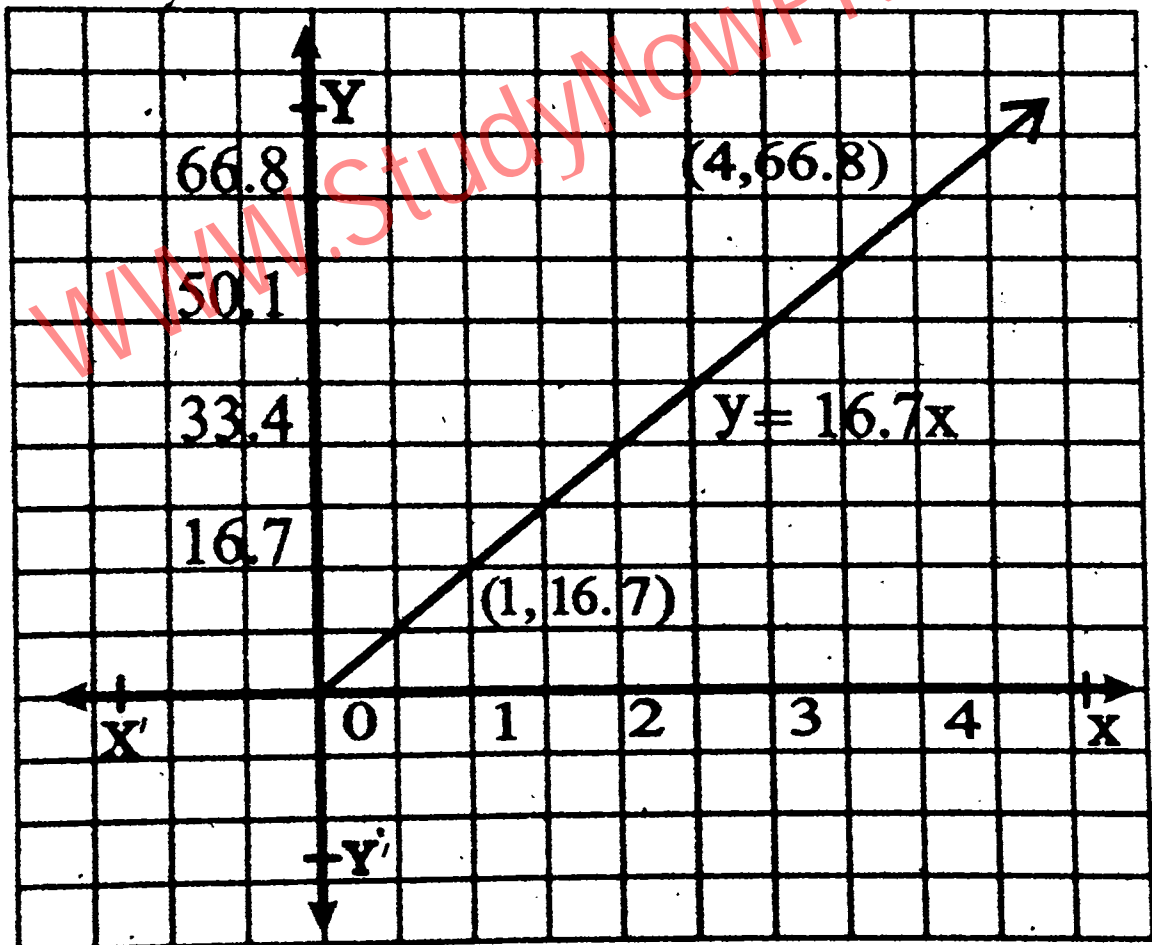
1 S. Riyal = 16.70 Rupees

Solution:

$y = 16.70\,x$

The table for values of x and y is as under:

x	0	1	2	4
y	0	16.7	33.4	66.8

Plotting these points and joining them we get the graph of $y = 16.7\,x$ as under:

Q3. Sketch the graph for following lines.

(a) $x - 3y + 2 = 0$ **(b)** $3x - 2y - 1 = 0$

(c) $2y - x + 2 = 0$ **(d)** $y - 2x = 0$

(e) $3y - 1 = 0$ **(f)** $y + 3x = 0$

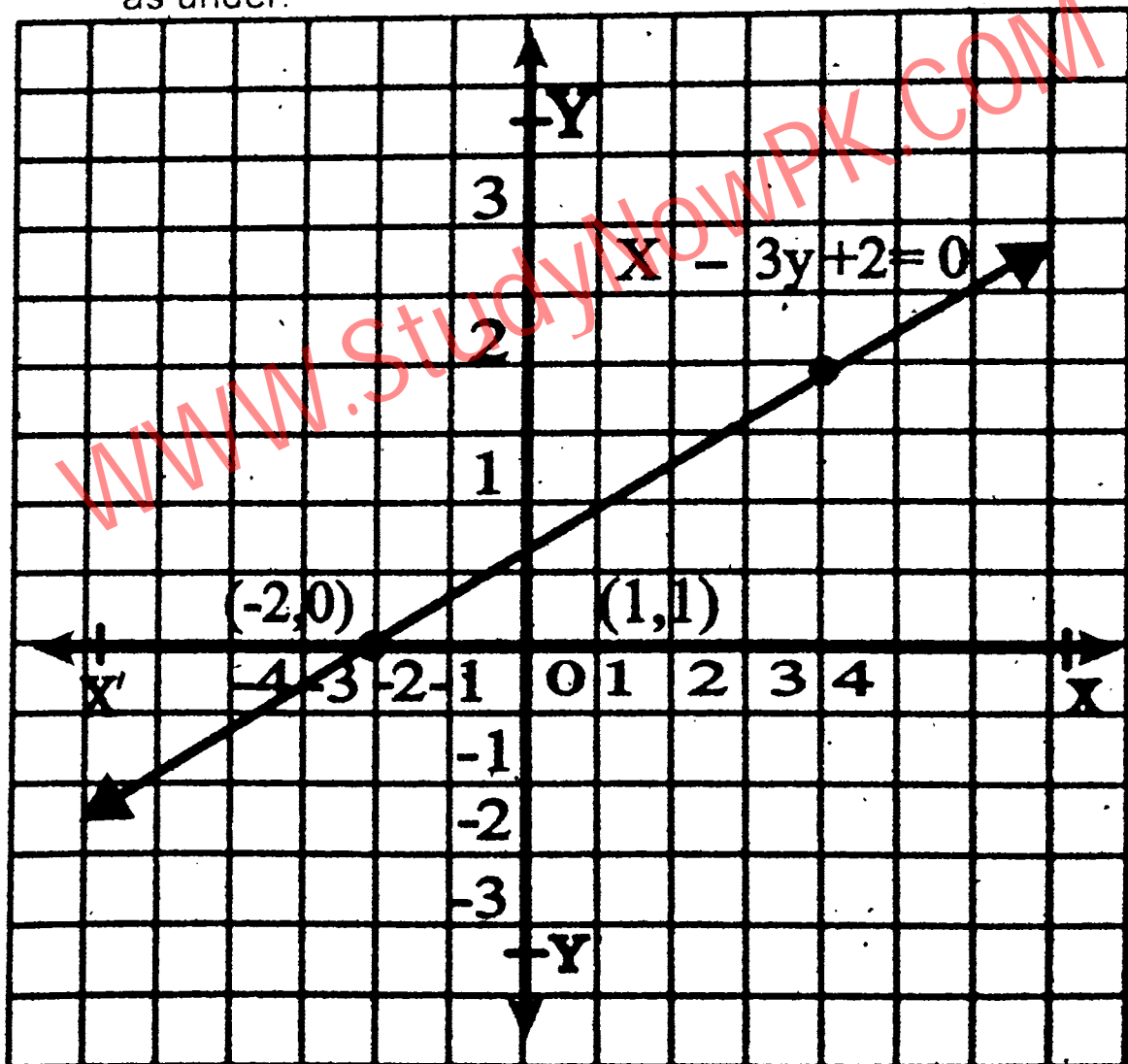
(g) $2x + 6 = 0$

(a) $x - 3y + 2 = 0$

or $y = \frac{x+2}{3}$

We tabulate the values of (x, y) as under:

x	-2	-1	0	1	2	3	4
y	0	0.3	0.66	1	1.3	2.66	2

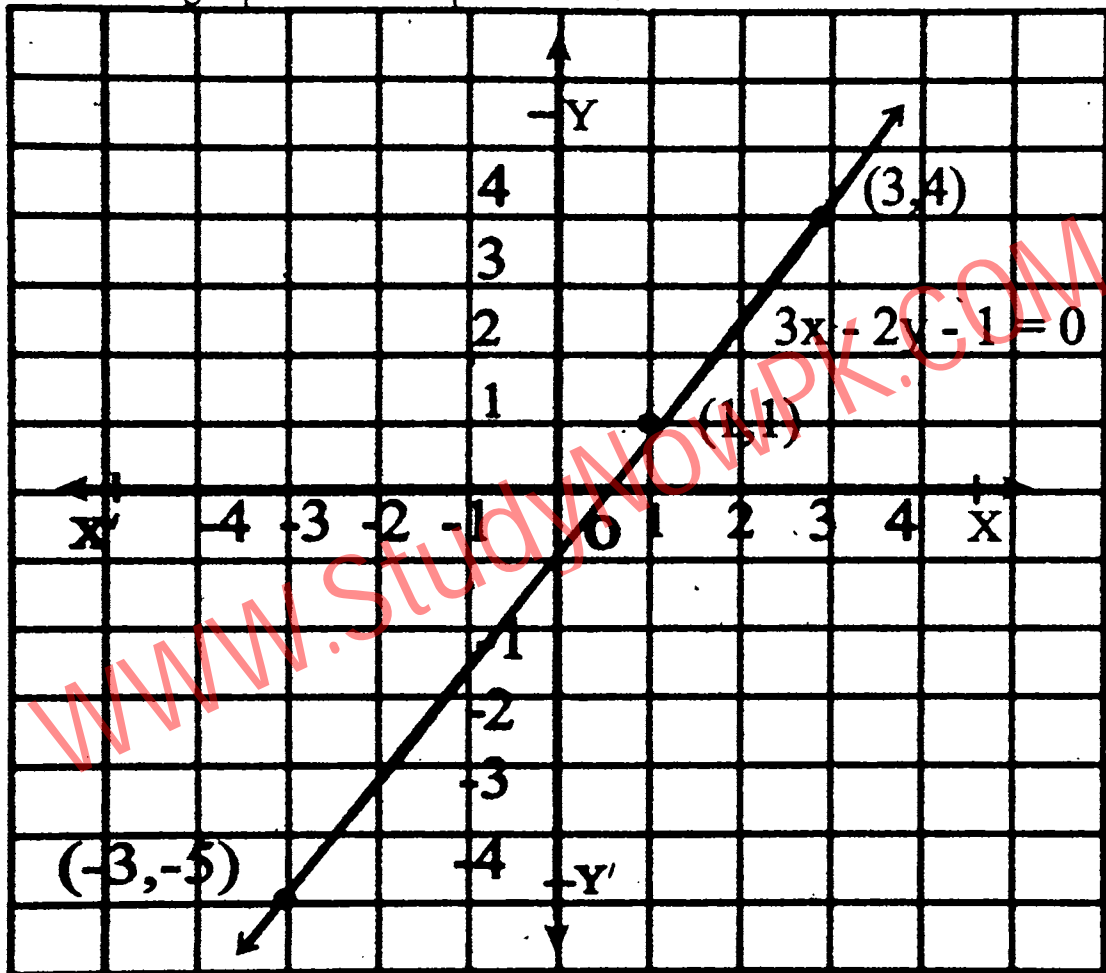
Plotting these points we get the graph of the equation as under:

(b) $\mathbf{3x - 2y - 1 = 0}$

or $3x - 1 = 2y$

or $y = \frac{3x-1}{2}$

We tabulate the values of (x, y) as under:

x	-3	-2	-1	0	1	2	3
y	-5	-3.5	-2	-0.5	1	2.5	4

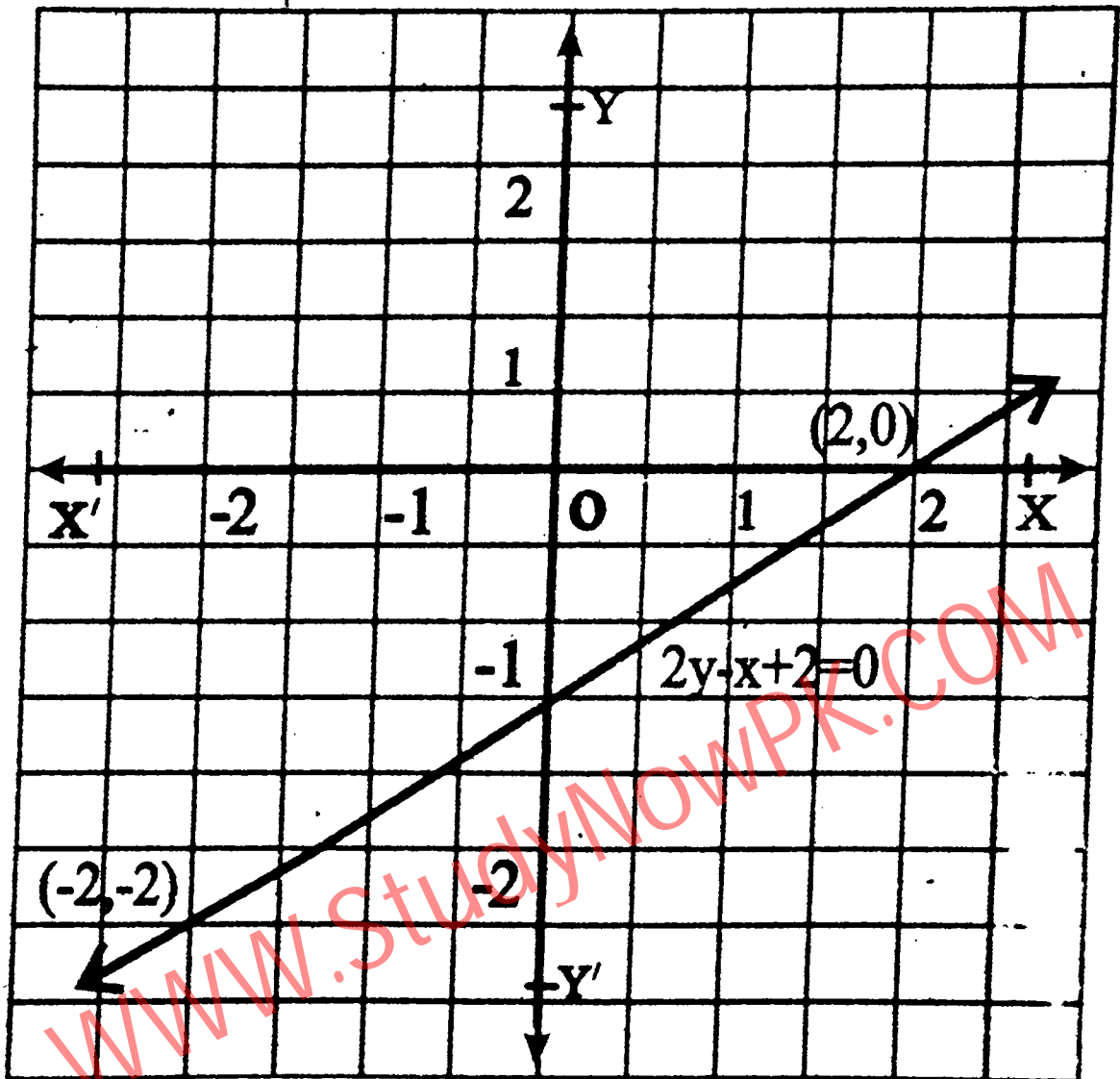
Plotting the values of x and y and joining these we get the graph of the equation as under:

(c) $\mathbf{2y - x + 2 = 0}$

or $2y = x - 2$

or $y = \frac{x-2}{2}$

We calculate the values (x, y) as under:

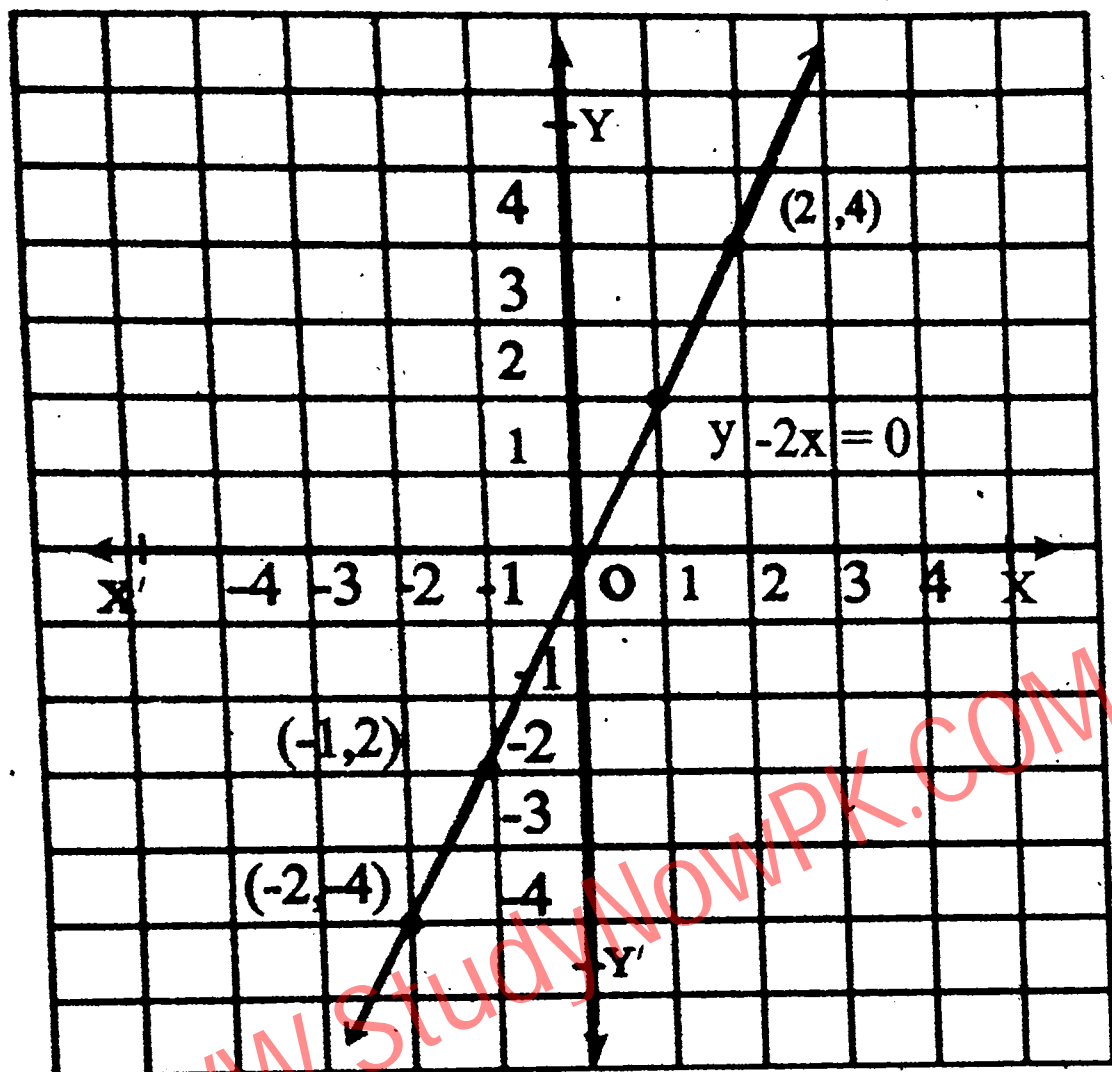
x	-2	-1	0	1	2
y	-2	-1.5	-1	-0.5	0

Plotting these points and joining them we get the graph of the equation as under

(d) $\mathbf{y - 2x = 0}$

or $y = 2x$

We tabulate the values of (x, y) as under:

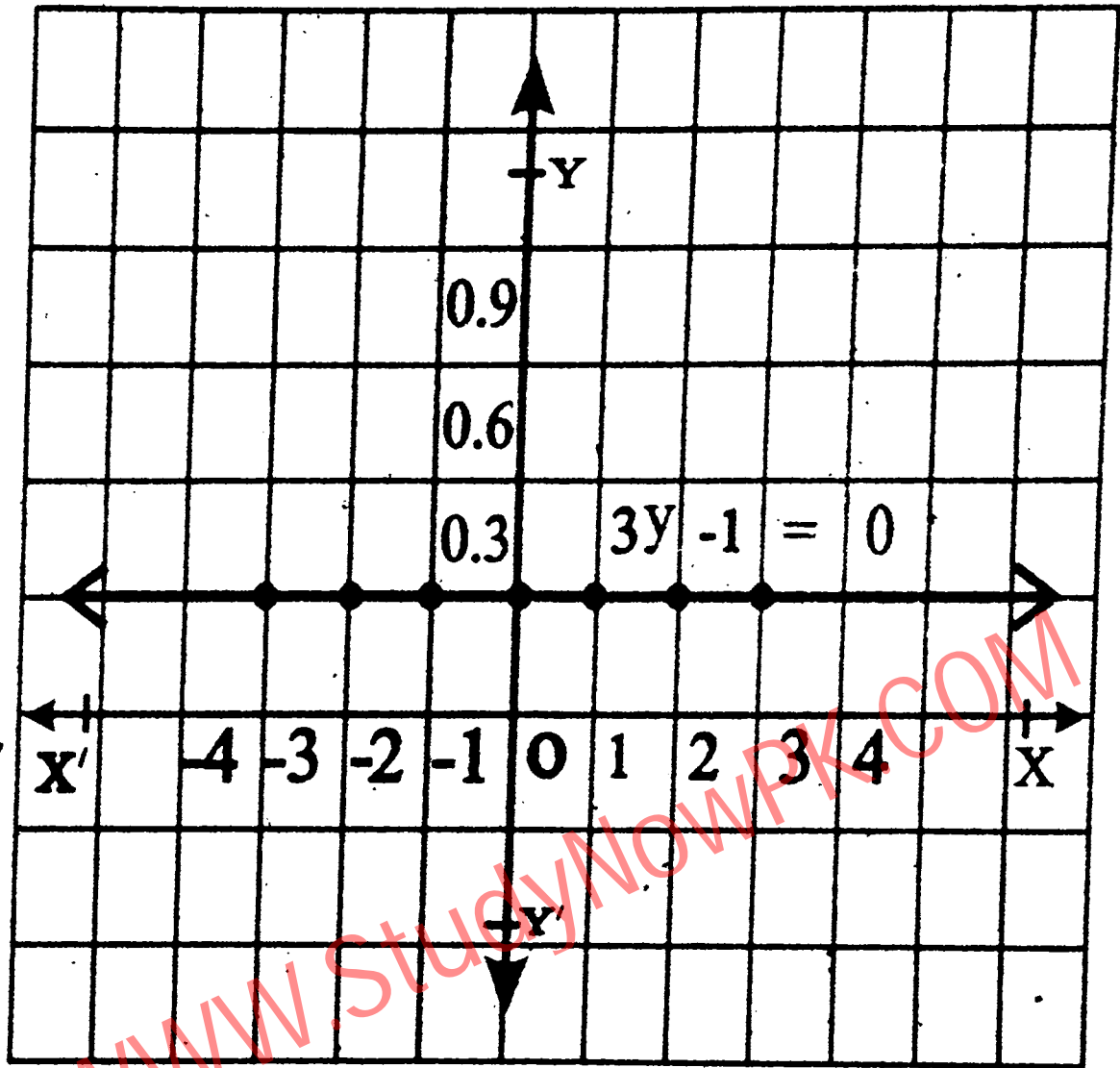
x	−2	−1	0	1	2
y	−4	−2	0	2	4

Plotting these points and joining them we get the graph of the equation as under:

(e) 3y − 1 = 0

or $y = \frac{1}{3} = 0.3$

We tabulate the values of y against x as under:

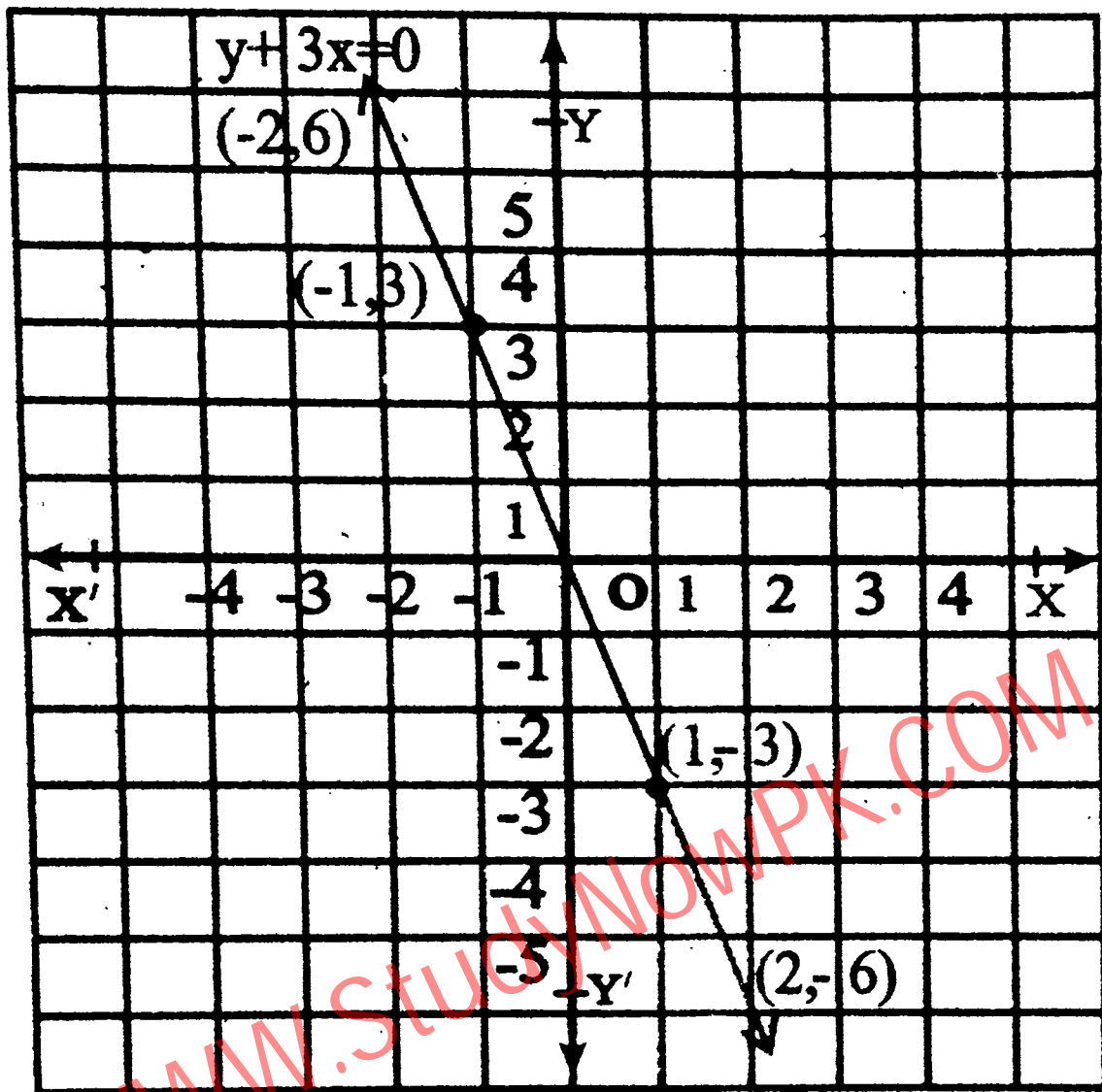
x	...	2	1	0	1	2
y	0.3	0.3	0.3	0.3	0.3	0.3

Plotting these points in the plane and joining them we get the graph of the equation 3y − 1 = 0.

(f) **$y + 3x = 0$**

or $y = -3x$

We tabulate the points (x, y) as under:

x	−2	−1	0	1	2
y	6	3	0	−3	−6

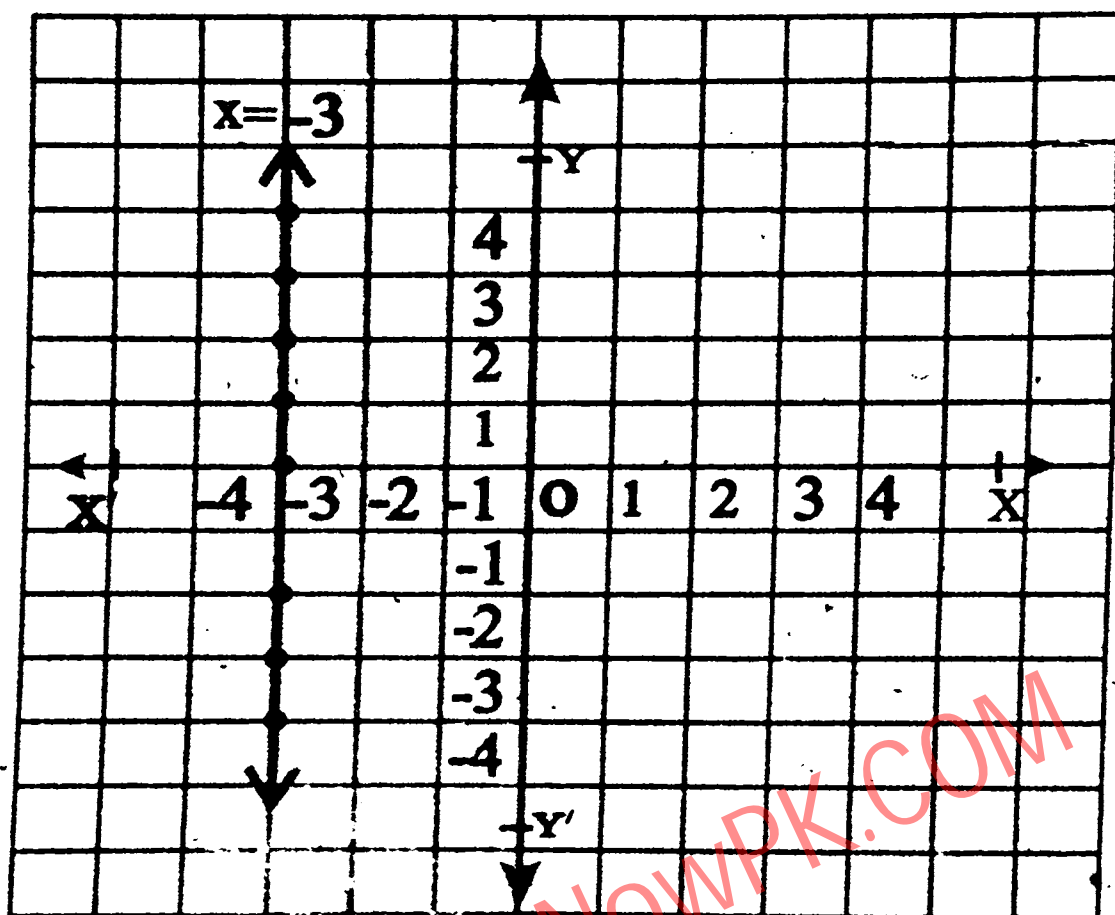
Plotting these points and joining them we get the graph of the equation $y + 3x = 0$ is under:

(g) **2x + 6 = 0**

or $\quad 2x = -6$

or $\quad x = -3$

We tabulate the points of the equation.

x	–3	–3	–3	–3	–3	–3
y	–2	–1	0	1	2	...

Plotting them joining them we get the graph of the equation as under.

Q4. Draw the graph for following relations.

(i) One mile = 1.6 km

(ii) One Acre = 0.4 Hectare

(iii) $F = \frac{9}{5}C + 32$

(iv) One Rupee = $\frac{1}{86}$ $

Solution:

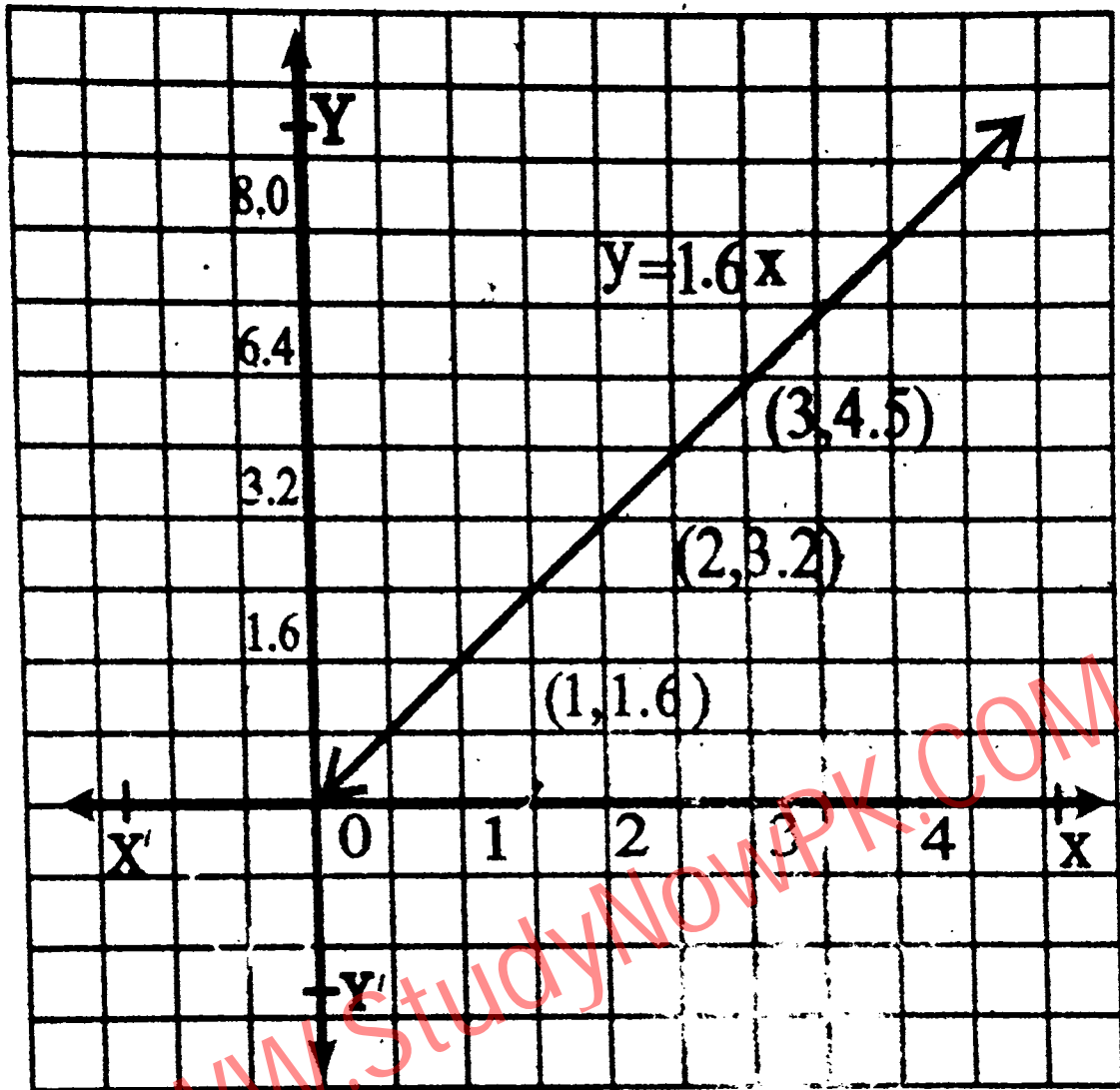
(i) One mile = 1.6 km

Let $y = 1.6x$

We tabulate value of x and y as under:

x	0	1	2	3	4
y	0	1.6	3.2	4.8	6.4

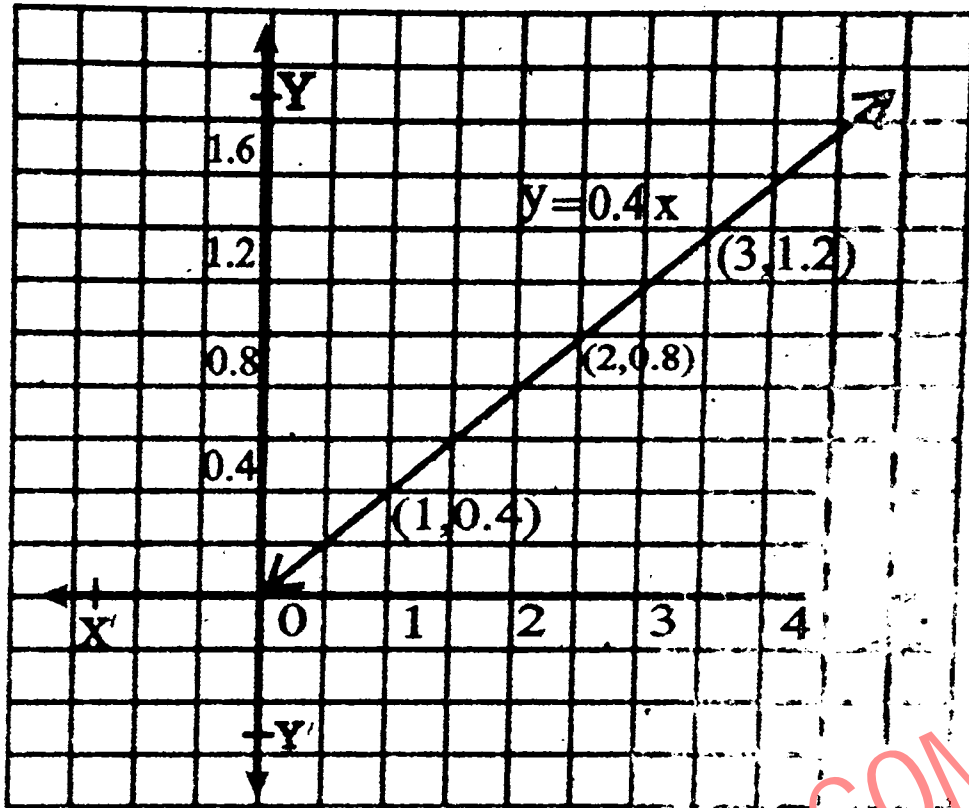
Mile is taken along x-axis and Km along y-axis.

We plot the point (x, y) and joining them we get the graph of $y = 1.6x$ i.e. conversion graph of miles and km.

(ii) On Acre = 0.4 Hectare

If Acre is measured along x-axis and hectare along y-axis then $y = 0.4x$

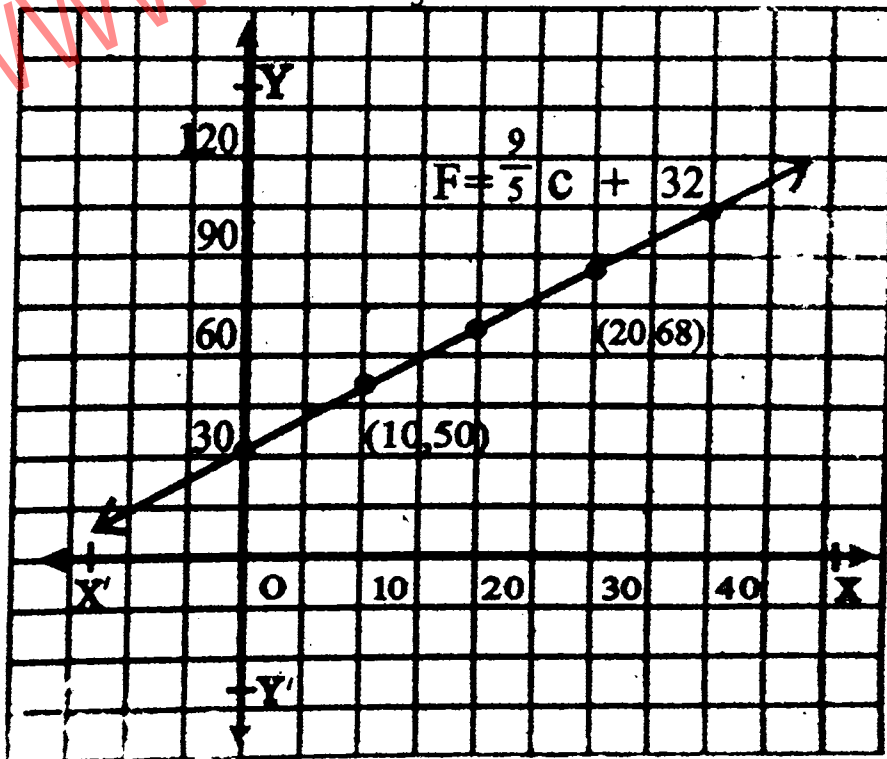
The ordered pairs are tabulated in the following table.

x	0	1	2	4
y	0	0.4	0.8	1.2

The corresponding points (0, 0), (1, 1.4), (2, 0.8) etc, are plotted in the xy-plane. Join of which forms the graph of conversion of $y = 0.4x$.

(iii) $F = \frac{9}{5}C + 32$

We tabulate the values of C and F

C	0°	10°	20°	30°	40°
F	32°	50°	68°	86°	104°

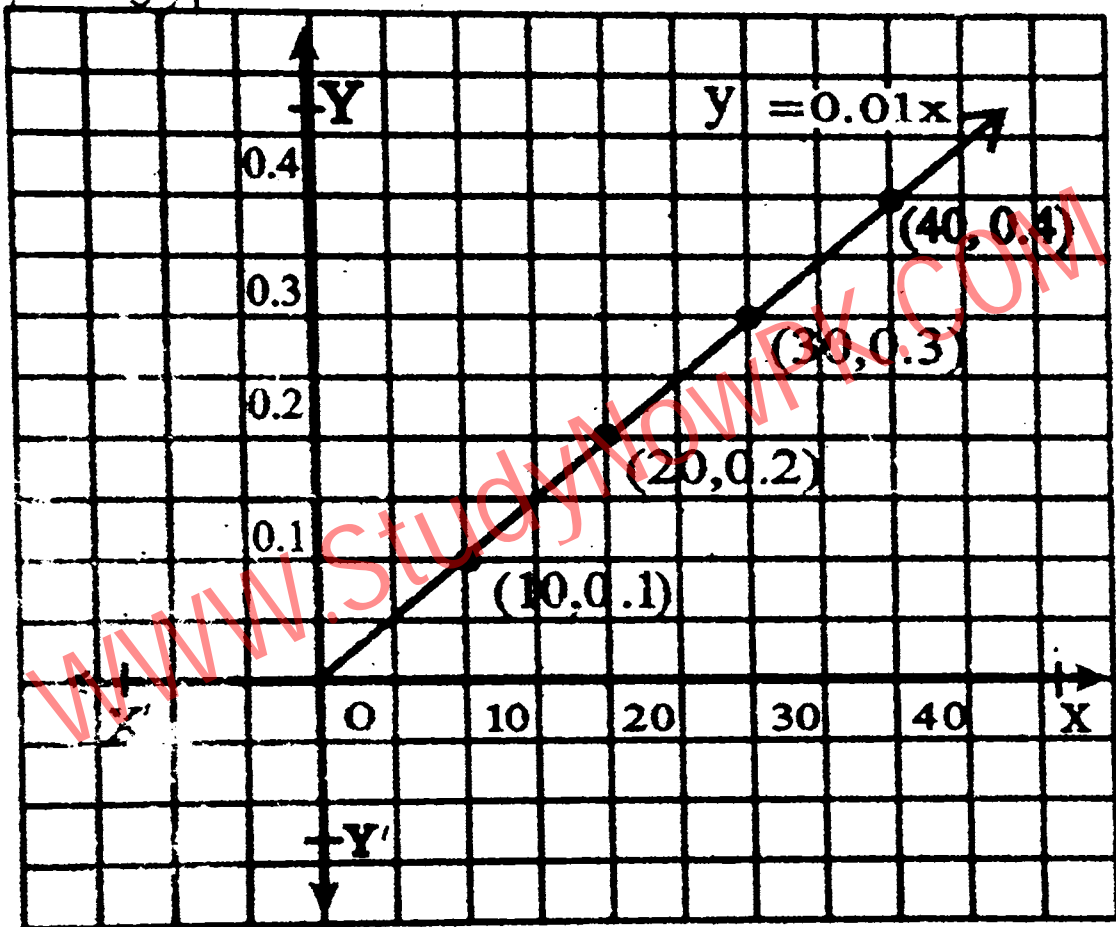
Plotting these points and joining them we get the required graph of $F = \frac{9}{5}C + 32$ as under:

(iv) **One Rupee = $\frac{1}{86}$ \$**

or One Rupee = 0.01\$

If \$ y is an expression of Rs. X, expressed under the rule y = 0.01 x

We tabulate the value of x and y as under:

x	0	10	20	30	40
y	0	0.1	0.2	0.3	0.4

Plotting the points corresponding to the ordered pairs (x, y) from the table and joining them we get the required graph.

EXERCISE 8.3

Solve the following pair of equations in x and y graphically.

Q1. $x + y = 0$ and $2x - y + 3 = 0$

Solution:

Let the system of the equations be

$x + y = 0$ (i)

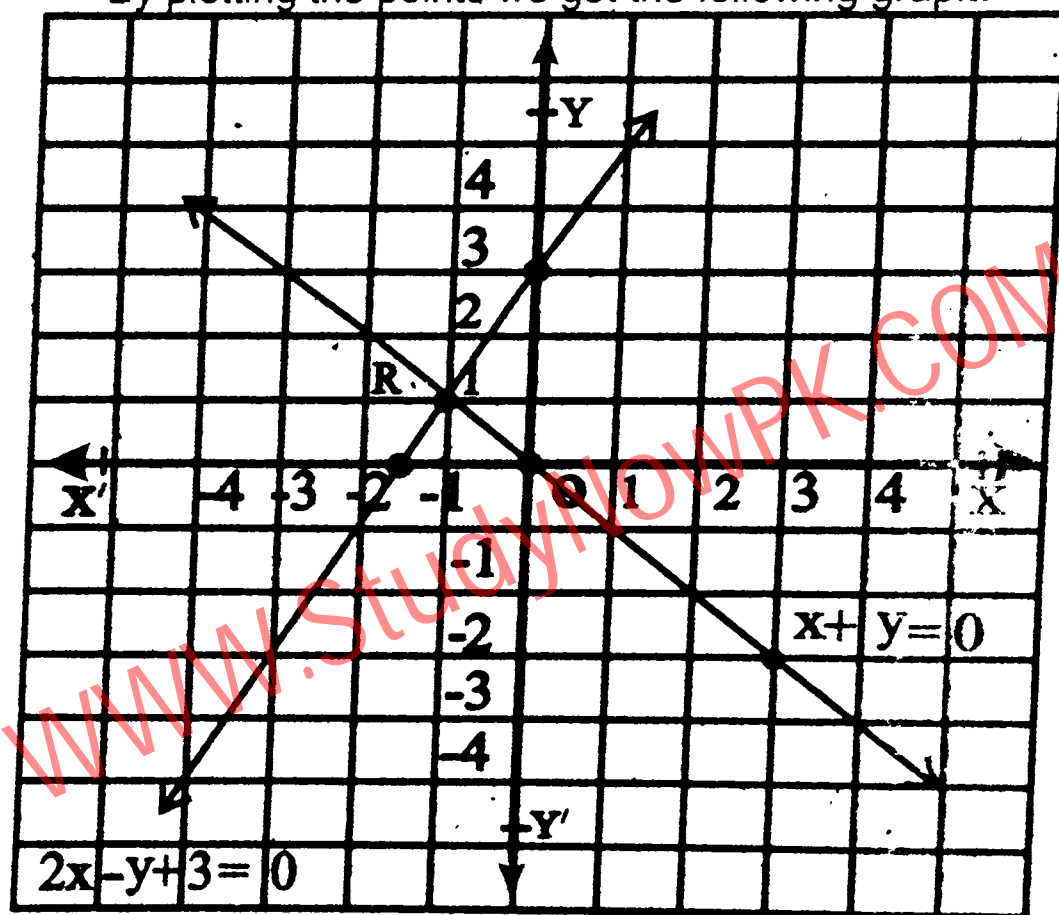
$2x - y + 3 = 0$ (ii)

For (i) $y = -x$ the table of values is

x	0	−1	2
y	0	1	−2

For (ii) $y = 2x + 3$, the table of values is

x	0	−1.5	−1
y	3	0	1

By plotting the points we get the following graph.

The solution of the system is the point R where the two lines meet i.e. **R(−1, 1)** such that $x = -1$, $y = 1$.

Q2. $x - y + 1 = 0$ and $x - 2y = -1$

Solution:

Let the system of equations be

$x - y + 1 = 0$ (i)

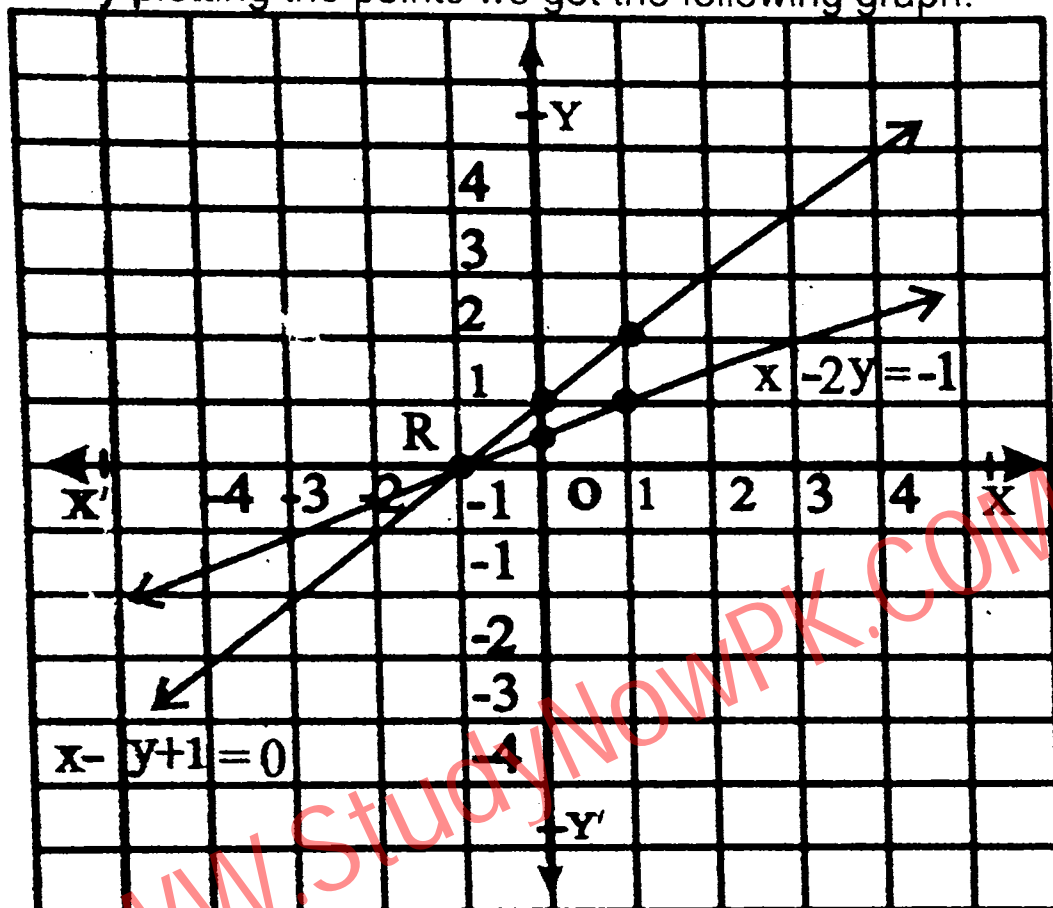
$x - 2y = -1$ (ii)

For (i) $y = x + 1$, the table of values is

x	0	−1	1
y	1	0	2

For (ii) $y = \frac{x+1}{2}$, the table of values is

x	0	–1	1
y	0.5	0	1

By plotting the points we get the following graph.

The solution of the system is the point R where the two lines meet i.e. **R(–1, 0)** $x = -1, y = 0$.

Q3. $2x + y = 0$ and $x + 2y = 2$

Solution:

Let the system of equations be

$2x + y = 0$ (i)

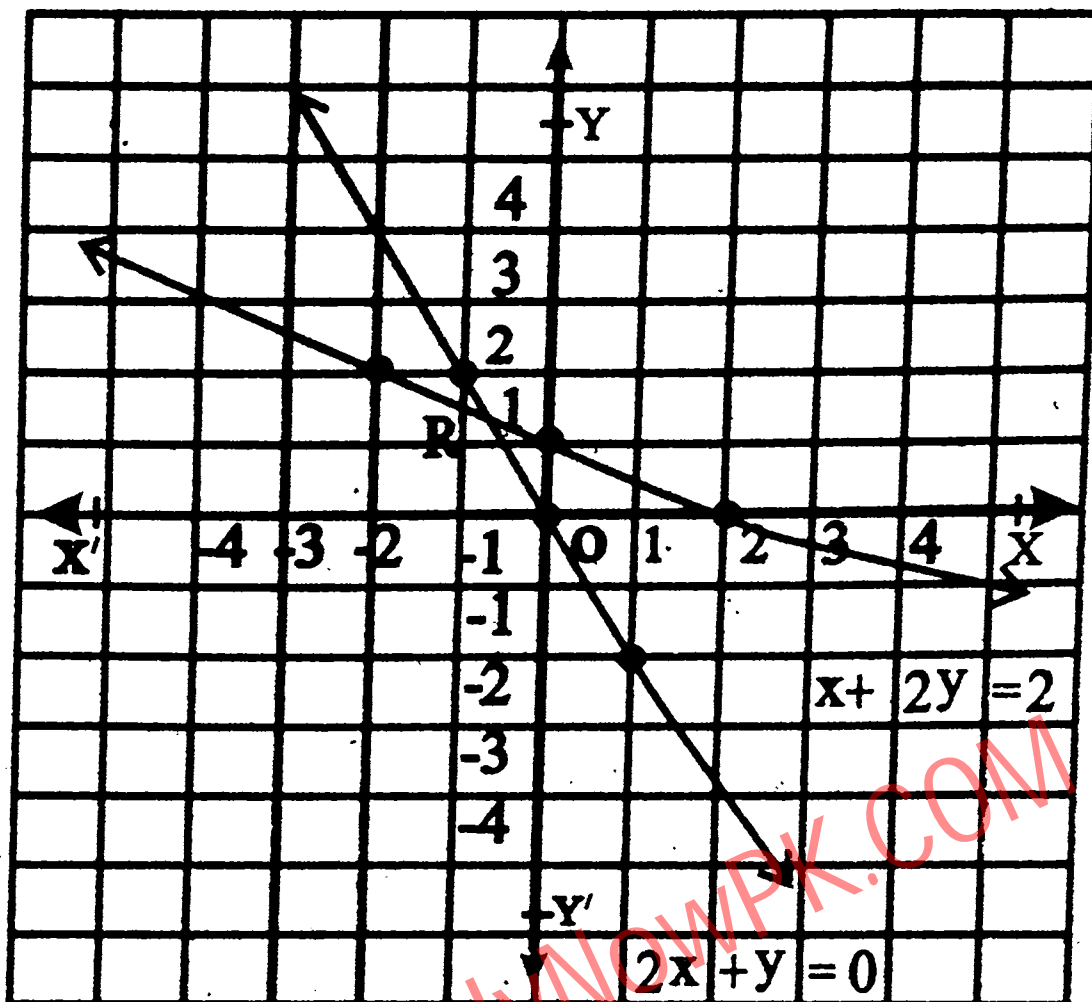
$x + 2y = 2$ (ii)

For (i) $y = -2x$, the table of values is

x	0	–1	1
y	0	2	–2

For (ii) $y = \frac{2-x}{2}$, the table of values is

x	0	2	–2
y	1	0	2

By plotting the points we get the following graph.

The solution of the system is the point R where the two lines meet i.e. **R** $\left(-\frac{2}{3}, \frac{4}{3}\right)$

$x = -\frac{2}{3}$, $\quad y = \frac{4}{3}$

Q4. $\mathbf{x + y - 1 = 0}$ **and** $\mathbf{x - y + 1 = 0}$

Solution:

Let the system of equations be

$x + y - 1 = 0 \qquad$ (i)

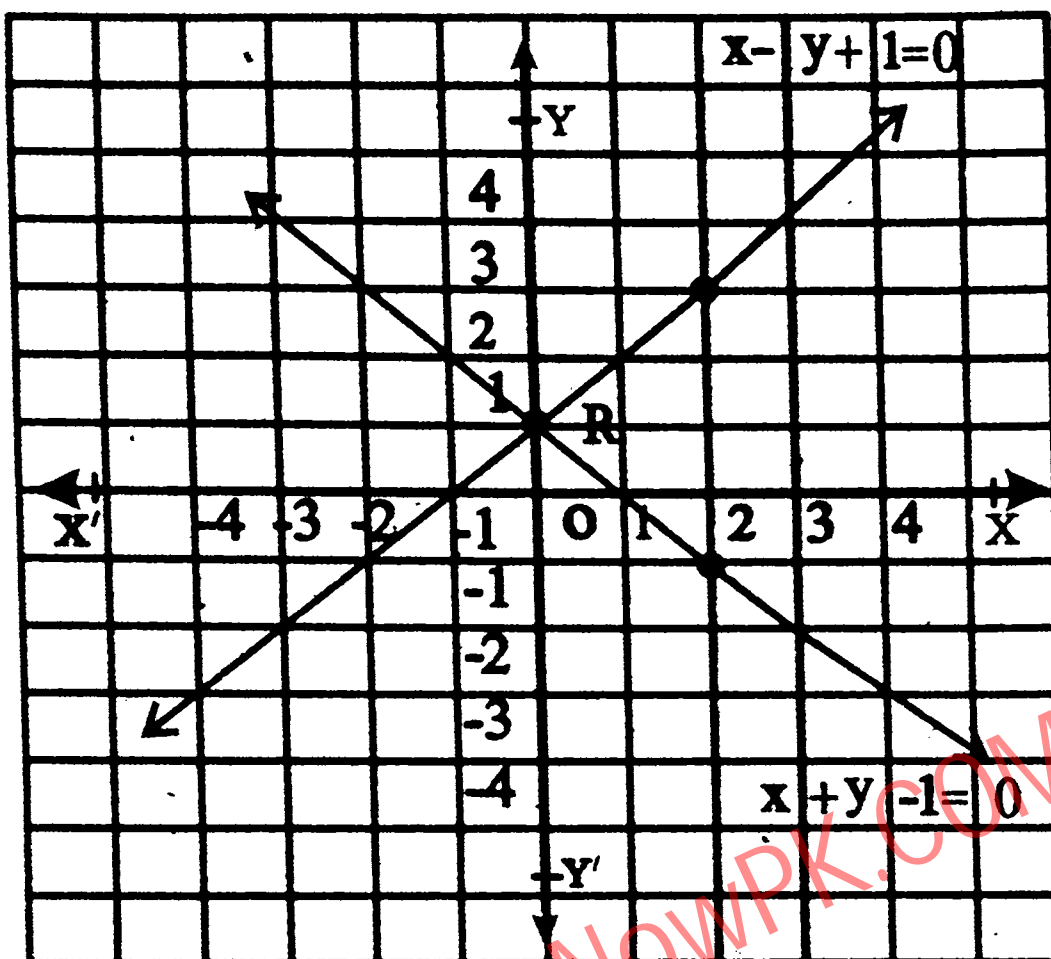
$x - y + 1 = 0 \qquad$ (ii)

For (i) $y = 1 - x$, the table of values is

x	0	1	2
y	1	0	−1

For (ii) $y = x + 1$, the table of values is

x	0	−1	2
y	1	0	3

By plotting the points we get the following graph.

The solution of the system is the point R where the two lines meet i.e. **R(0, 1)**

or $x = 0, y = 1$.

Q5. **$2x + y - 1 = 0$ and $x = -y$**

Solution:

Let the system of equation be

$2x + y - 1 = 0$ **(i)**

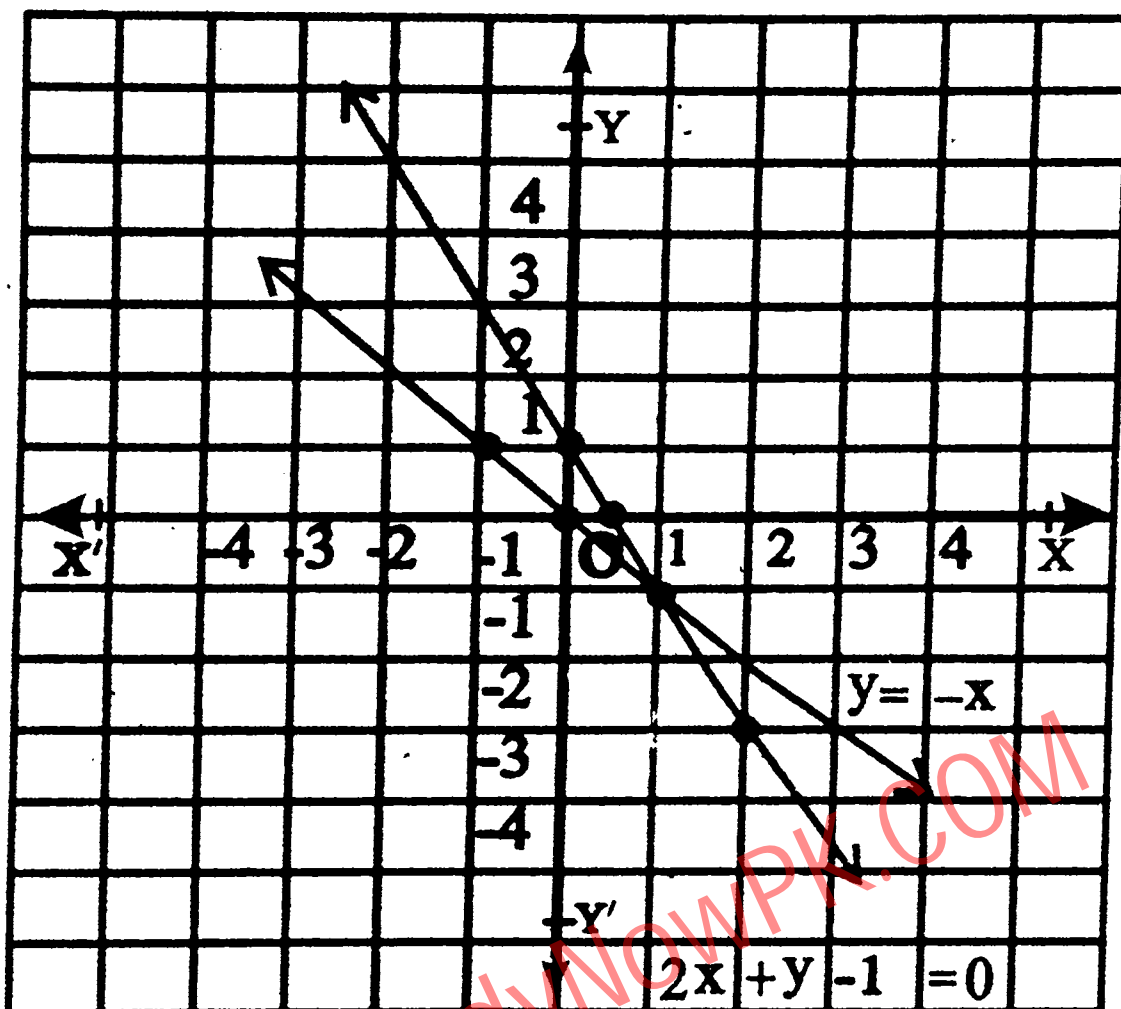
$x = -y$ **(ii)**

For (i) $y = 1 - 2x$, the table of values is

x	0	0.5	2
y	1	0	−3

For (ii) $y = -x$, the table of values is

x	0	1	−1
y	0	−1	1

By plotting the points we get the following graph:

The solution of the system is the point R where the two lines meet i.e. R(1, −1)

$x = 1, \quad y = -1$

REVIEW EXERCISE 8

Q1. Choose the correct answer.

(i) If $(x - 1, y + 1) = (0, 0)$, then (x, y) is

(a) $(1, -1)$ (b) $(-1, 1)$

(c) $(1, 1)$ (d) $(-1, -1)$

(ii) If $(x, 0) = (0, y)$, then (x, y) is

(a) $(0, 1)$ (b) $(1, 0)$

(c) $(0, 0)$ (d) $(1, 1)$

(iii) Point $(2, -3)$ lies in quadrant

(a) I (b) II

(c) III (d) IV

(iv) Point (−3, −3) lies in quadrant

(a) I	(b) II
(c) III	(d) IV

(v) If $y = 2x + 1$, $x = 2$ then y is

(a) 2	(b) 3
(c) 4	(d) 5

(vi) Which ordered pair satisfy the equation $y = 2x$.

(a) (1, 2)	(b) (2, 1)
(c) (2, 2)	(d) (0, 1)

Answers:

(i) a	(ii) c	(iii) d	(iv) c	(v) d	(vi) a

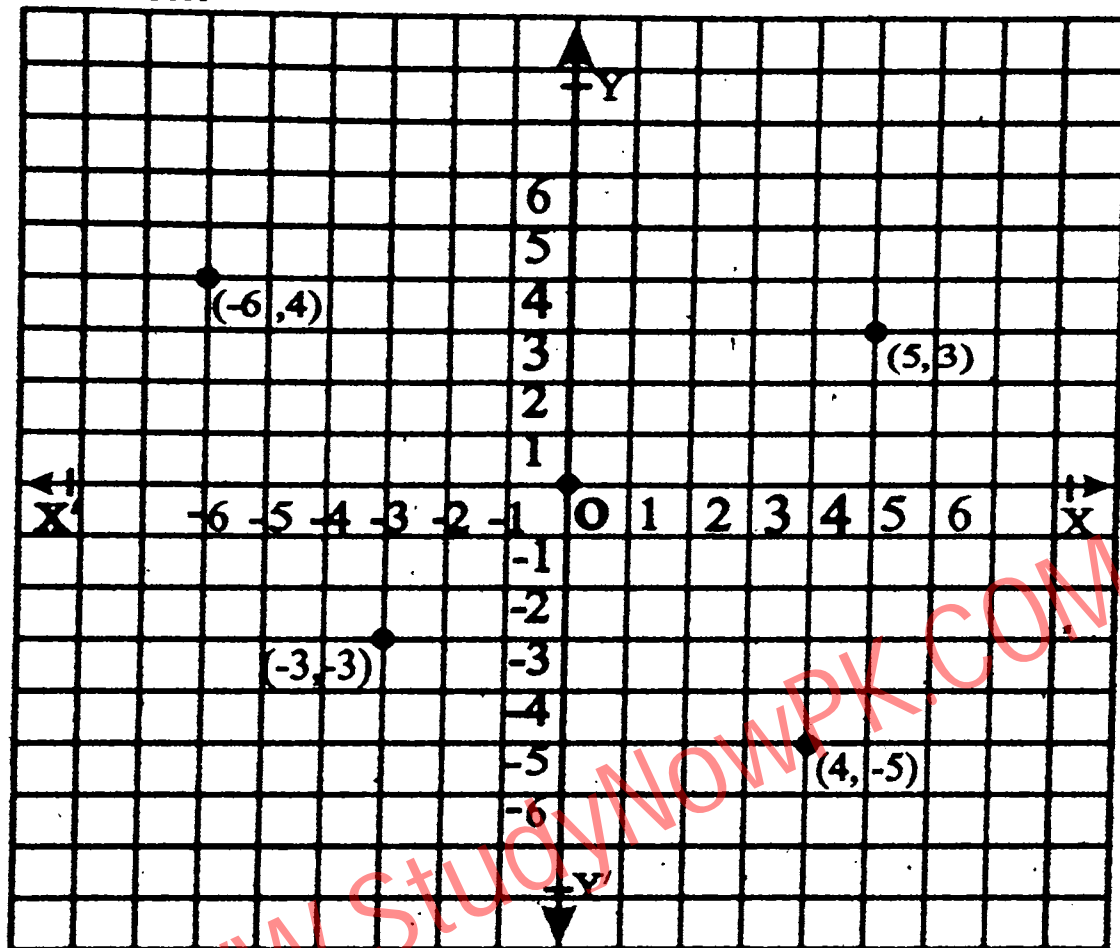
Q2. Identify the following statements as True or False.

(i) The point O(0, 0) is in quadrant II.
(ii) The point P(2, 0) lies on x-axis.
(iii) The graph of $x = -2$ is a vertical line.
(iv) $3 - y = 0$ is a horizontal line.
(v) The point Q(−1, 2) is in quadrant III.
(vi) The point R(−1, −2) is in quadrant IV.
(vii) $y = x$ is a line on which origin lies.
(viii) The point P(1, 1) lies on the line $x + y = 0$
(ix) The point S(1, −3) lies in quadrant III.
(x) The point R(0, 1) lies on the x-axis.

Answers:

(i) F	(ii) T	(iii) T	(iv) T	(v) F
(vi) F	(vii) T	(viii) F	(ix) F	(x) F

Q3. Draw the following points on the graph paper.
(−3, −3), (−6, 4), (4, −5), (5, 3)

Solution:

Q4. Draw the graph of the following.

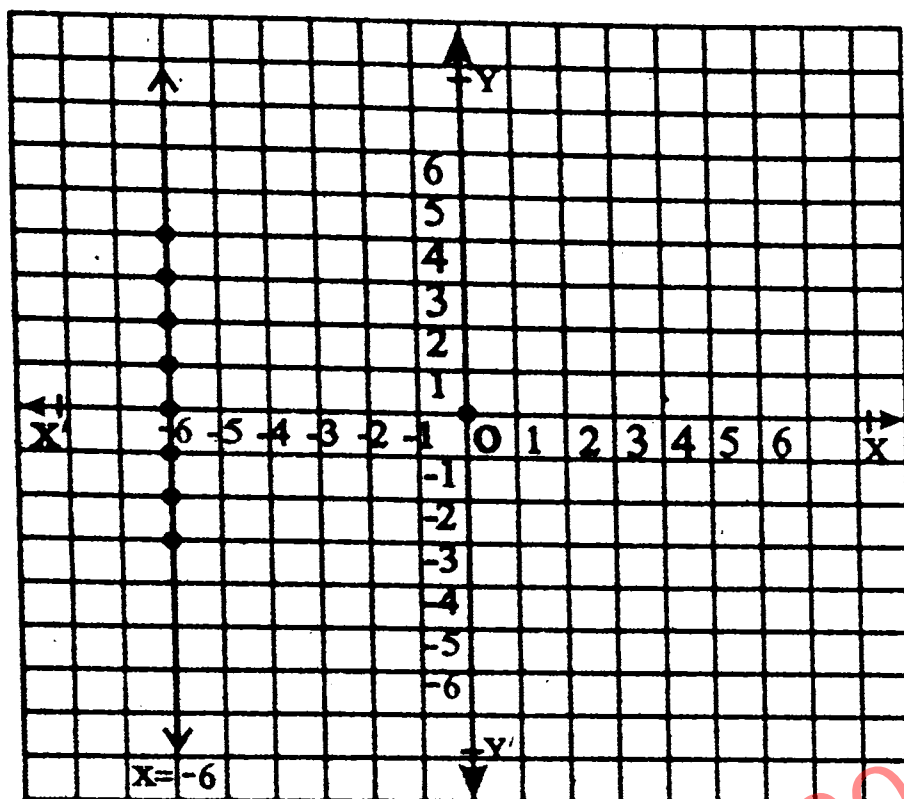
(i)	$x = -6$	**(ii)**	$y = 7$
(iii)	$x = \frac{5}{2} = 2.5$	**(iv)**	$y = -\frac{9}{2} = -4.5$
(v)	$y = 4x$	**(vi)**	$y = -2x + 1$

(i) $x = -6$

Solution:

We tabulate the values of x and y as

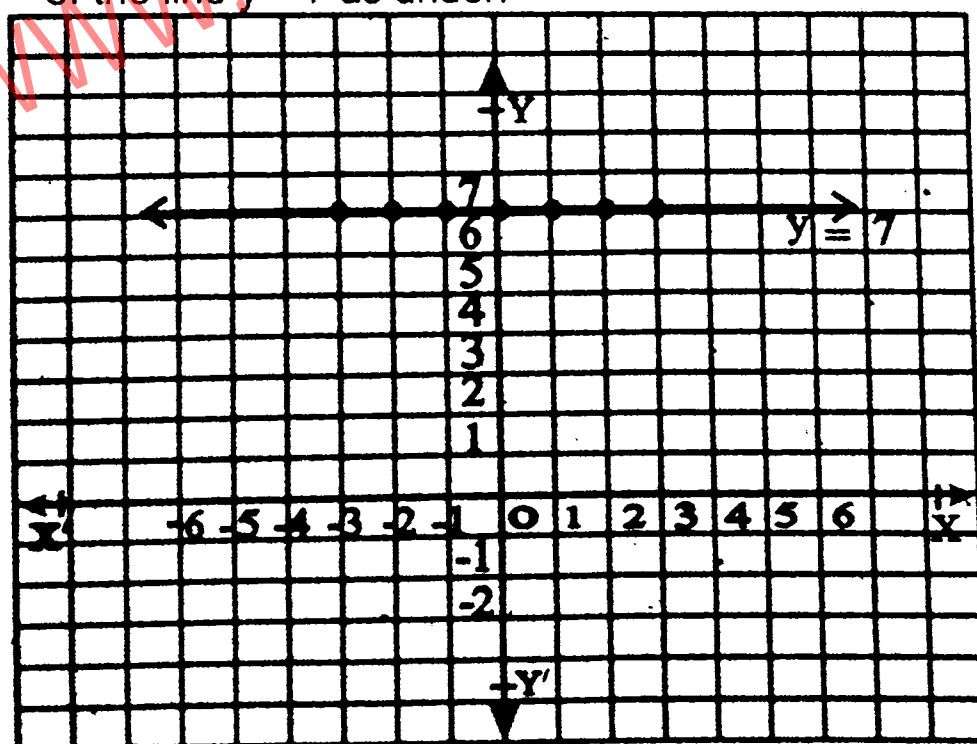
x	−6	−6	−6	−6	−6
y	−2	−1	0	1	2

Plotting these points and joining them we get the graph of the line x = −6 as under:

(ii) $y = 7$

Solution:

We tabulate the values of x and y as

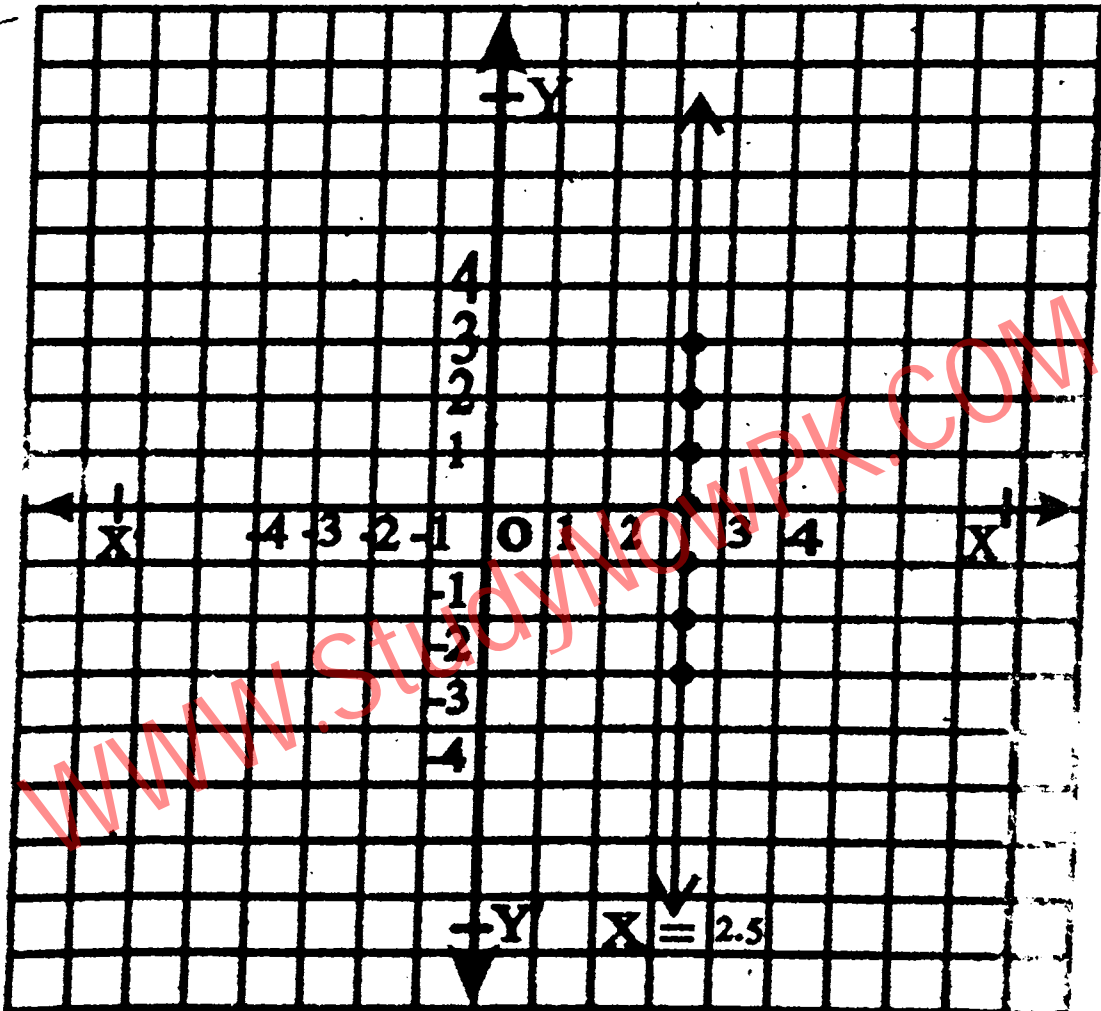
x	–2	–1	0	0	2
y	–7	7	7	7	7

Plotting these points and joining them we get the graph of the line $y = 7$ as under:

(iii) $x = \frac{5}{2} = 2.5$

Solution:

We tabulate the values of x and y as under:

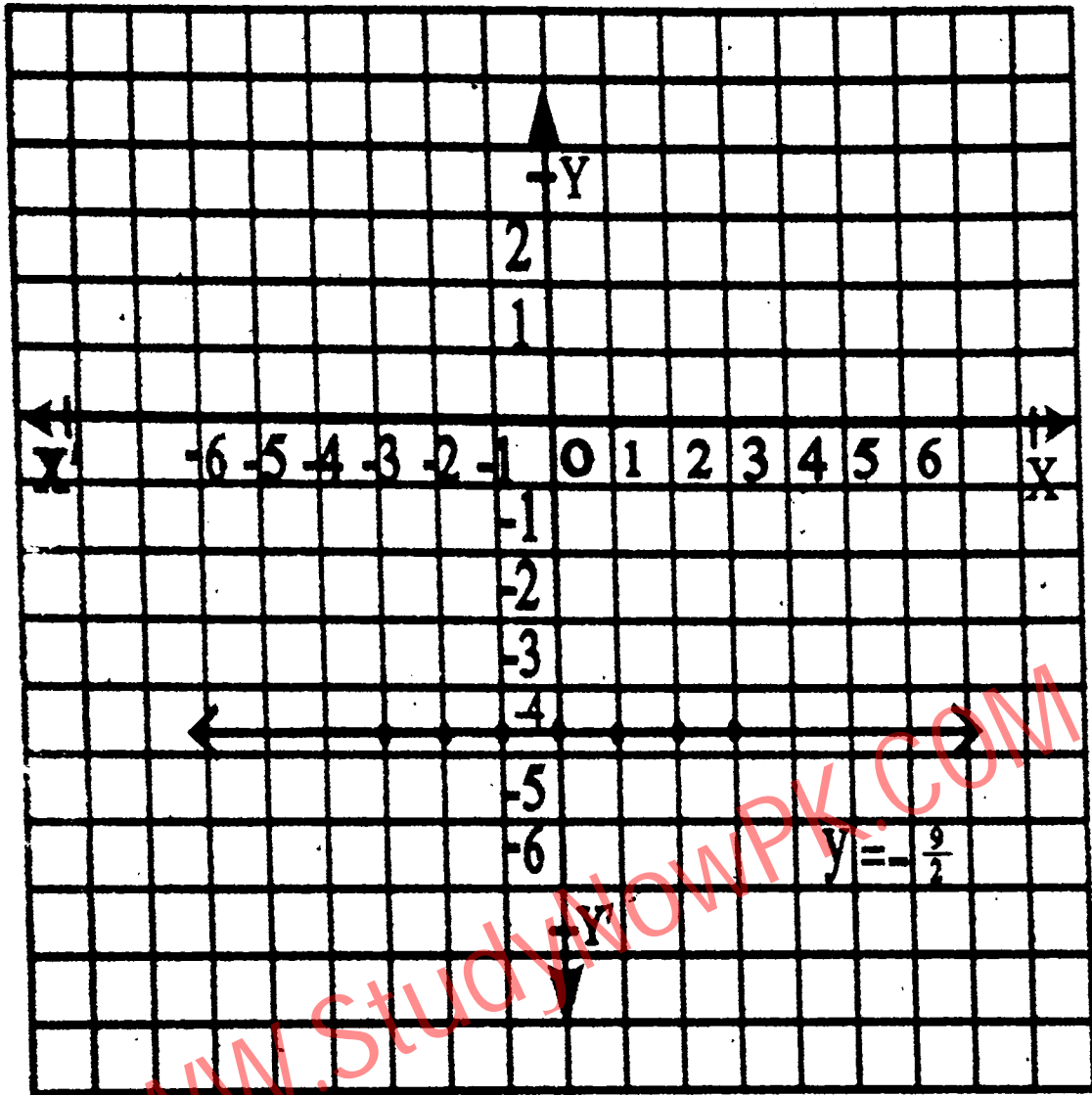
x	2.5	2.5	2.5	2.5	2.5
y	-2	-1	0	1	2

Plotting these and joining them we get the graph of the line x = 2.5 as under:

(iv) $y = -\frac{9}{2} = -4.5$

Solution:

We tabulate the value of x and y as under:

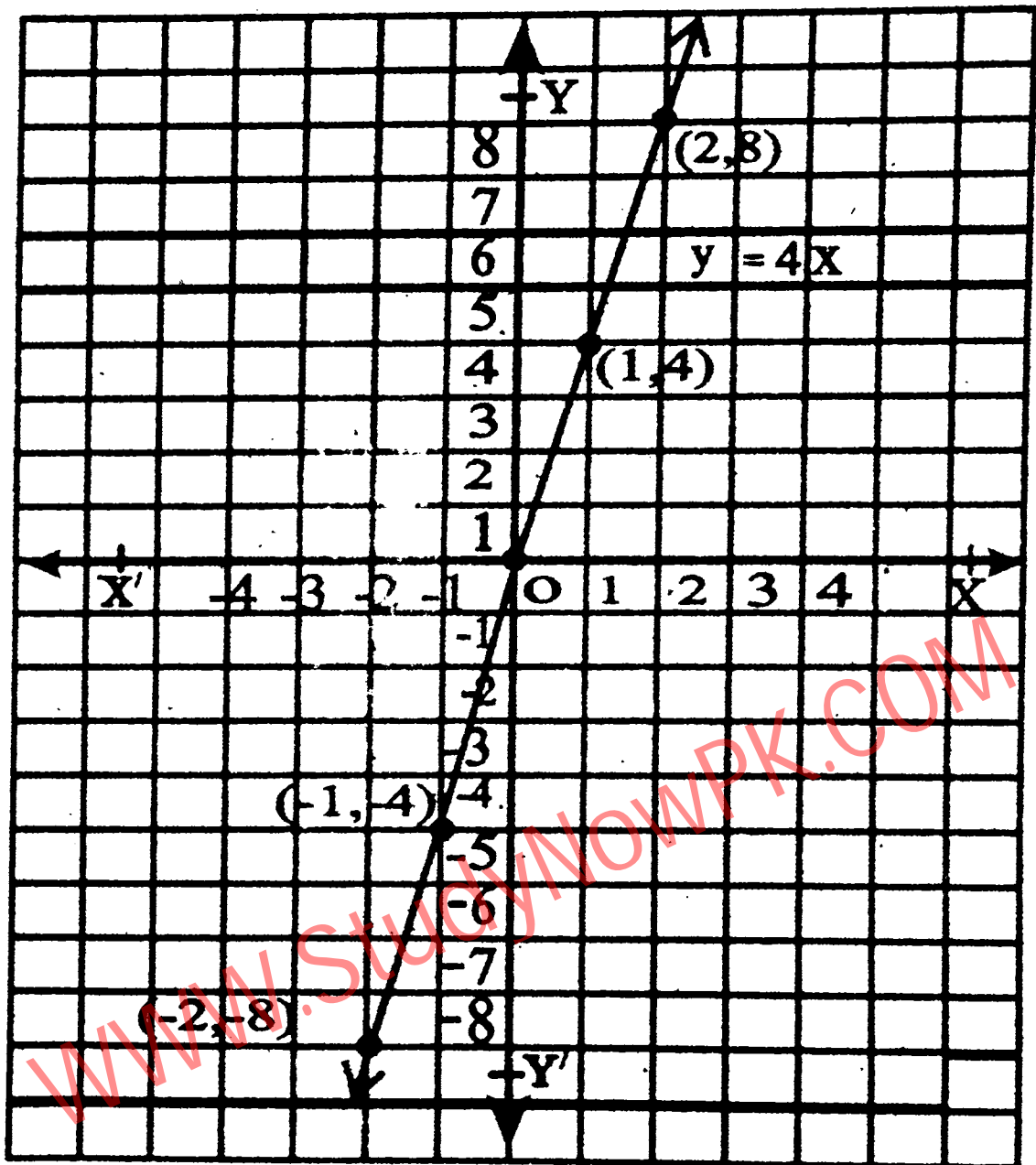
x	-2	-1	0	1	2
y	-4.5	-4.5	-4.5	-4.5	-4.5

Plotting these points and joining them we get the graph of the equation $x = -\frac{9}{2}$ as under:

(v) y = 4x

Solution:

We tabulate the values of x and y as under:

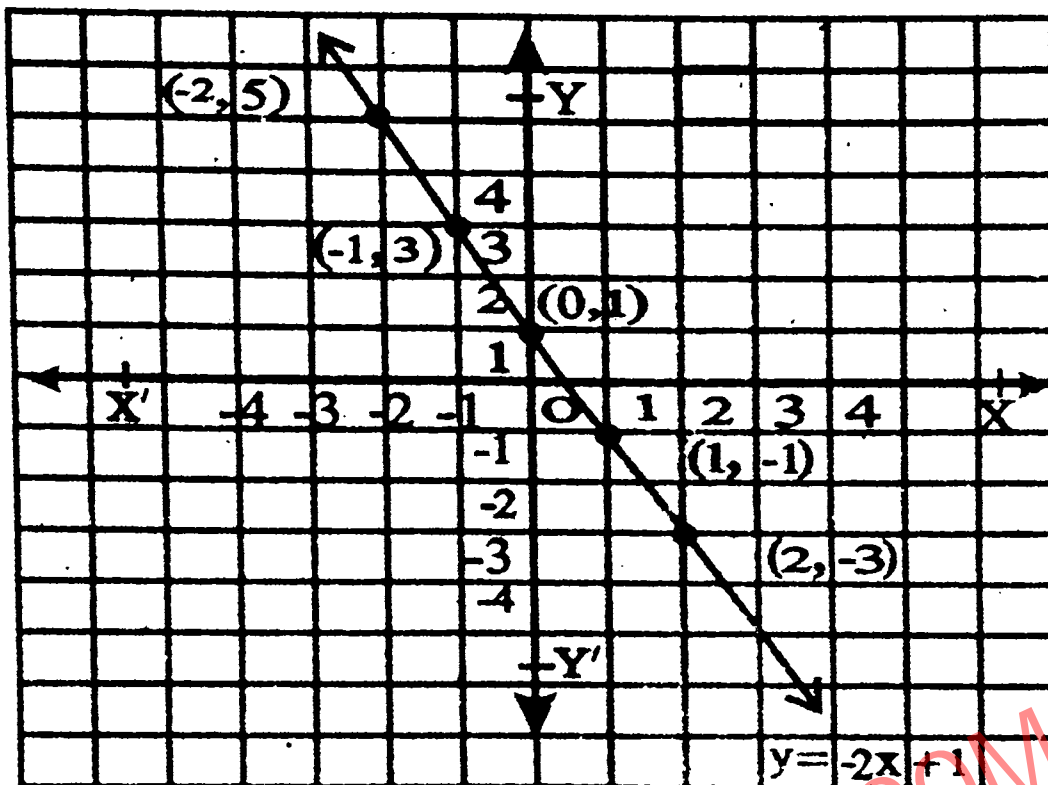
x	−2	−1	0	1	2	3
y	−8	−4	0	4	8	12

Plotting these points and joining them we get the graph the equation y = 4x as under:

(vi) $y = -2x + 1$

Solution:

We tabulate the value of x and y as under:

x	−2	−1	0	1	2
y	5	3	1	−1	−3

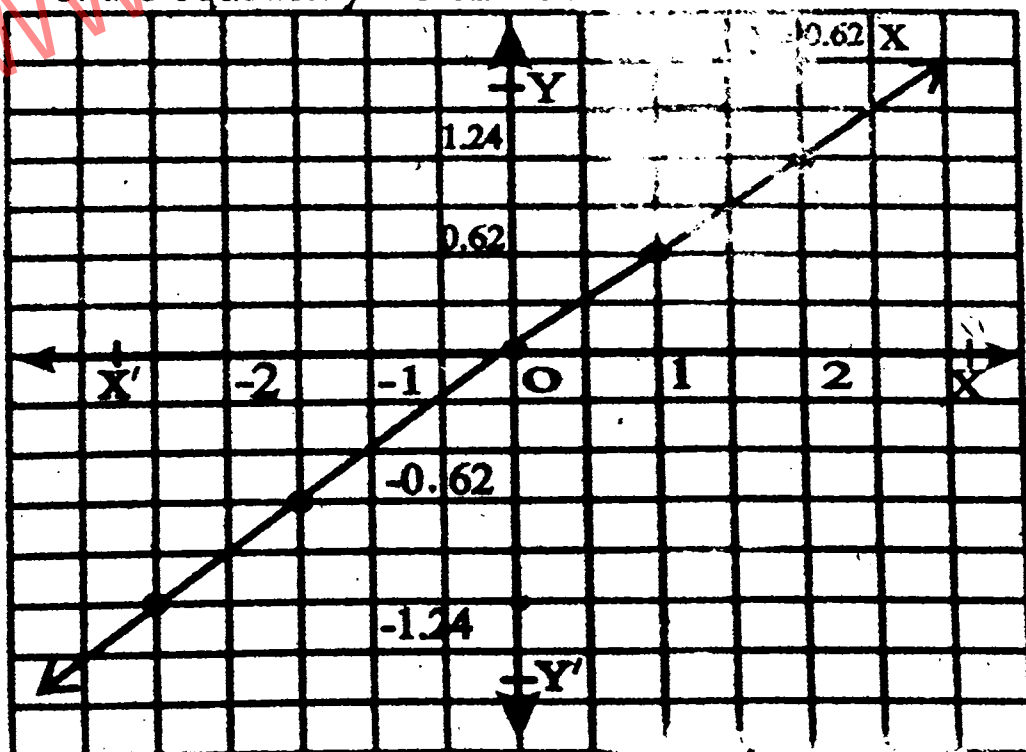
Plotting these points and joining them we get the graph of the equation $y = -2x + 1$ as under:

Q5. Draw the following graph.

(i) $y = 0.62\,x$

Solution:

We tabulate the values of x ar… …der:

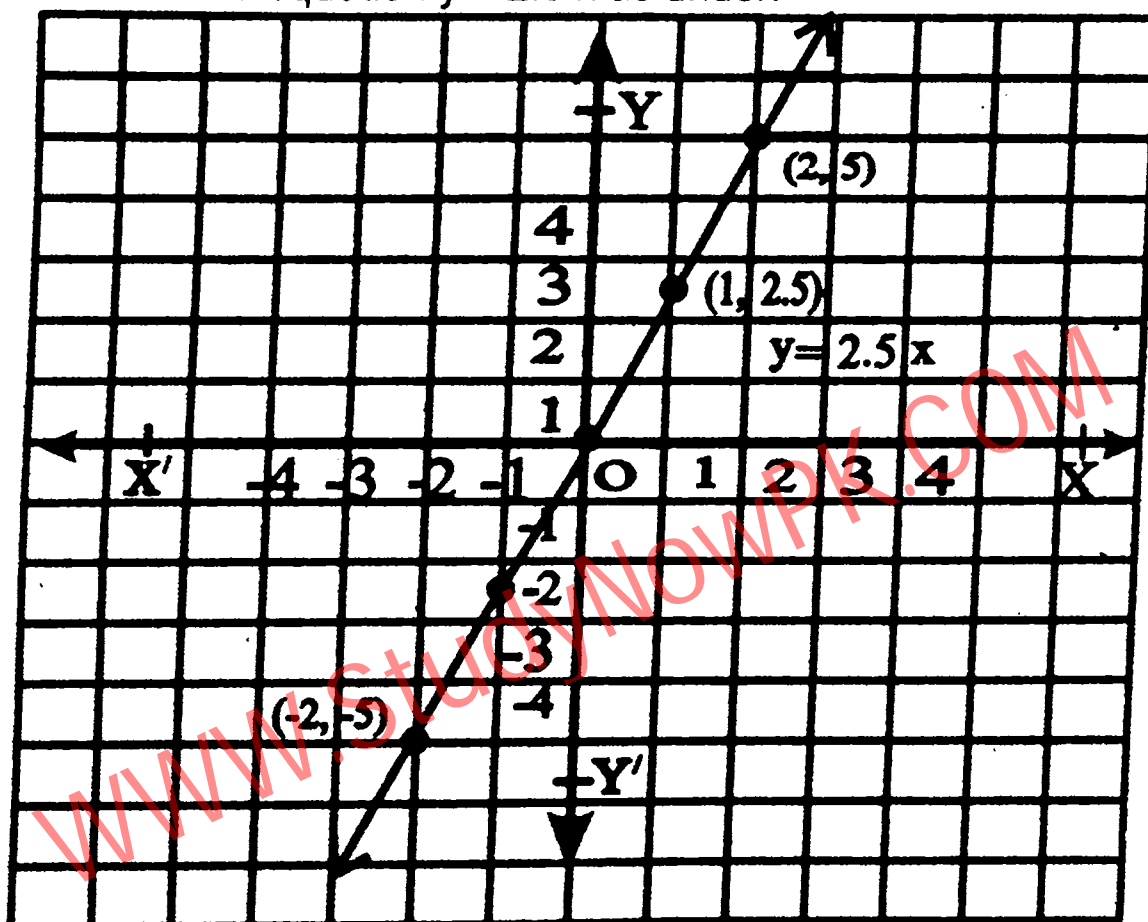
x	−2	−1	0	[illegible]	2
y	−1.24	−0.62	0	[illegible]	1.24

Plotting these points and joi… …e get the graph of the equation y = 0.62 x as u…

(ii) $y = 2.5x$

Solution:

We tabulate the values of x and y as under:

x	-2	-1	0	1	2
y	-5.0	-2.5	0	2.5	5.0

Plotting these points and joining them we get the graph of the equation $y = 2.5x$ as under:

Q6. Solve the following equations graphically.

(i) $x - y = 1,$ $\qquad x + y = \frac{1}{2}$

(ii) $x = 3y,$ $\qquad 2x - 3y = -6$

(iii) $\frac{1}{3}(x + y) = 2\frac{1}{2},$ $\qquad (x - y) = -1$

(i) $x - y = 1,$ $\qquad x + y = \frac{1}{2}$

Solution:

Let the system of equations be

$x - y = 1 \qquad$ (i)

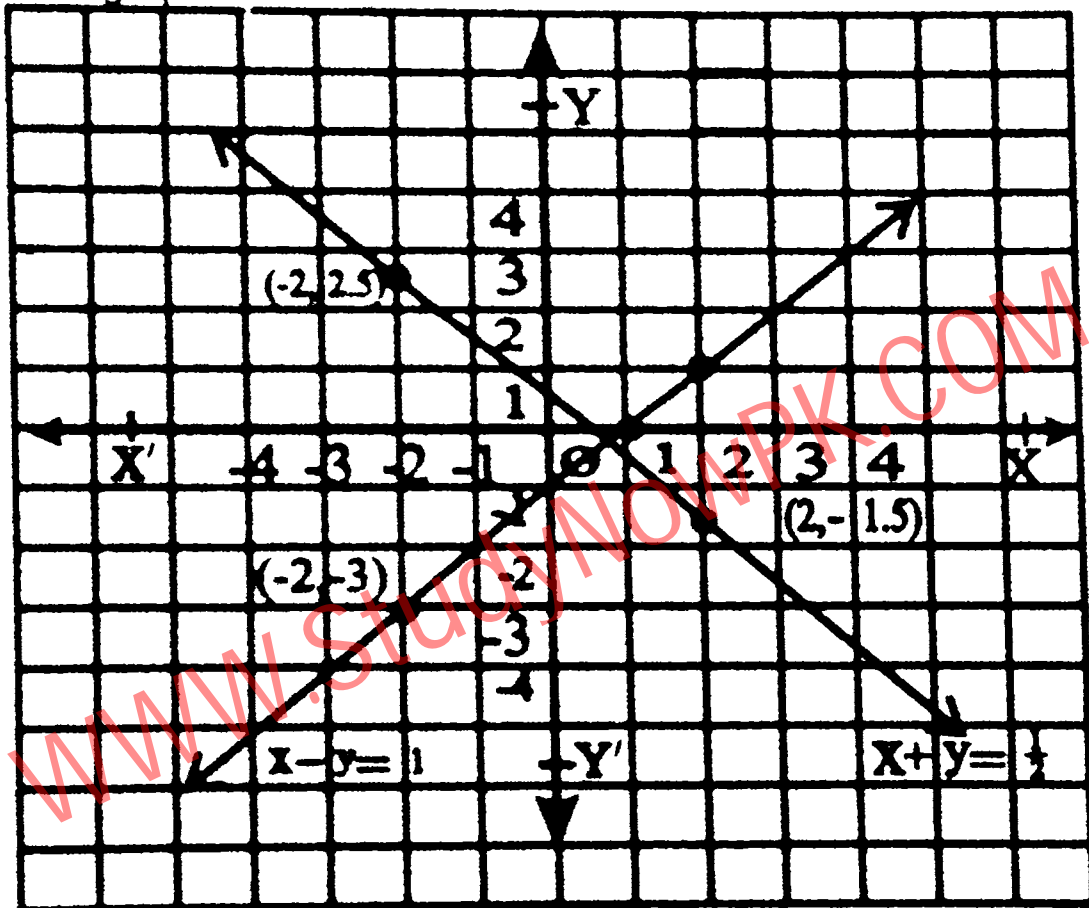
$x + y = \frac{1}{2} \qquad$ (ii)

For (i) $y = x - 1$, the table values is

x	-2	-1	0	1	2
y	-3	-2	-1	0	1

For (ii) $y = \frac{1}{2} - x$, the table of values is

x	-2	-1	0	1	2
y	2.5	1.5	0.5	-0.5	-1.5

By plotting the points of (i) and (ii) we get the following graph.

The solution set of the system is the point R

i.e. $R\left(\frac{3}{4}, -\frac{1}{4}\right)$ or (0.75, -0.25)

(ii) $\mathbf{x = 3y,}$ $\qquad$ $\mathbf{2x - 3y = -6}$

Solution:

Let the system of equations be

$x = 3y$ $\qquad$ or $\qquad$ $y = \frac{1}{3}x$ $\qquad$ (i)

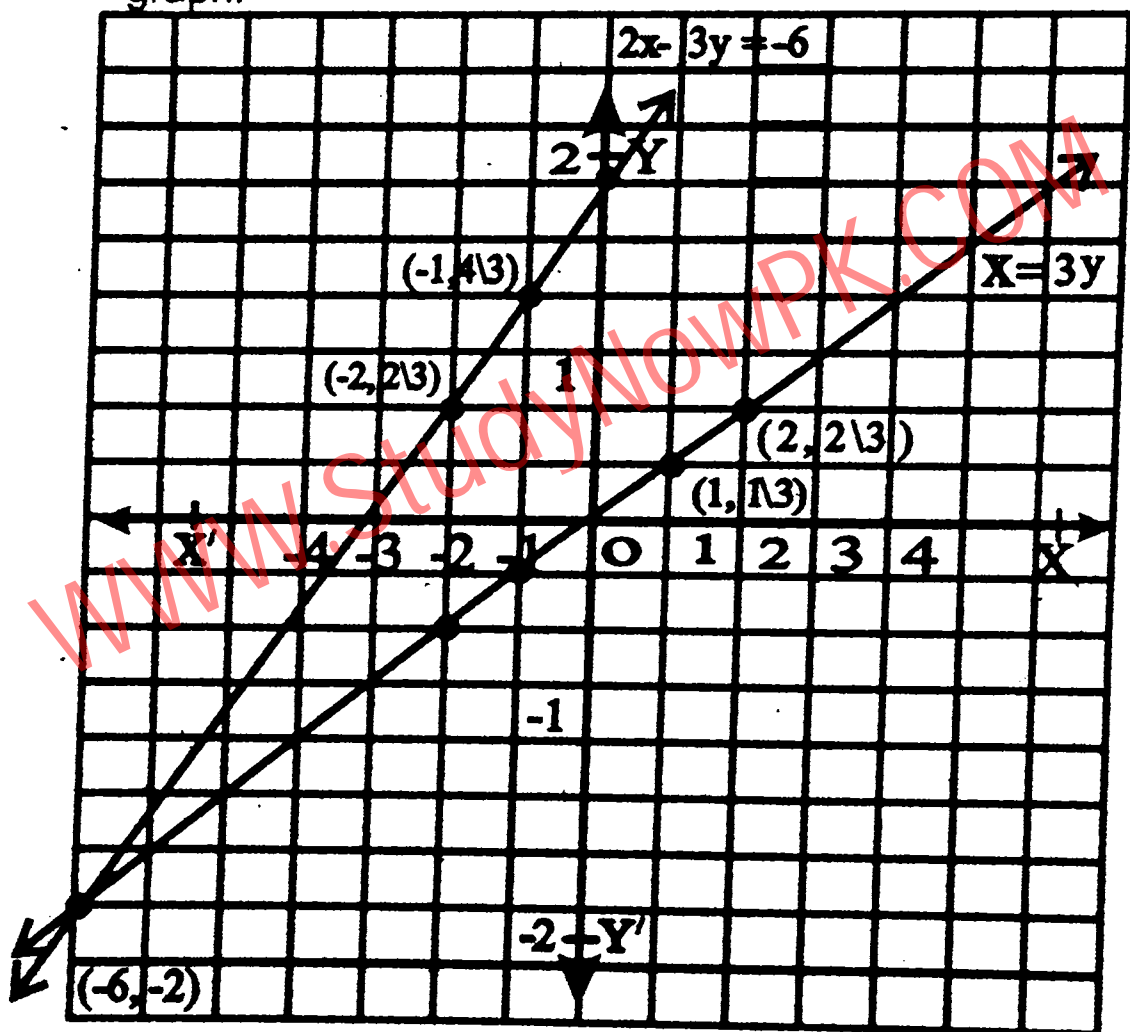
$2x - 3y = -6$ $\qquad$ (ii)

For (i) $y = \frac{1}{3}x$, the table of values is

x	-2	-1	0	1	2
y	$-\frac{2}{3}$	$-\frac{1}{3}$	0	$\frac{1}{3}$	$\frac{2}{3}$

For (ii), $y = \frac{2x+6}{3}$, the table of value is

x	-2	-1	0	1	2
y	$\frac{2}{3}$	$\frac{4}{3}$	2	$\frac{1}{8}$	$\frac{10}{3}$

By plotting the points of (i) and (ii) we get the following graph.

The solution set of the system is the point **R (–6, –2)**

i.e. $x = -6, y = -2$.

(iii) $\frac{1}{3}(x + y) = 2\frac{1}{2}$, **(x–y) = – 1**

Solution:

The system of equations is

$\frac{1}{3}(x + y) = 2$ (i)

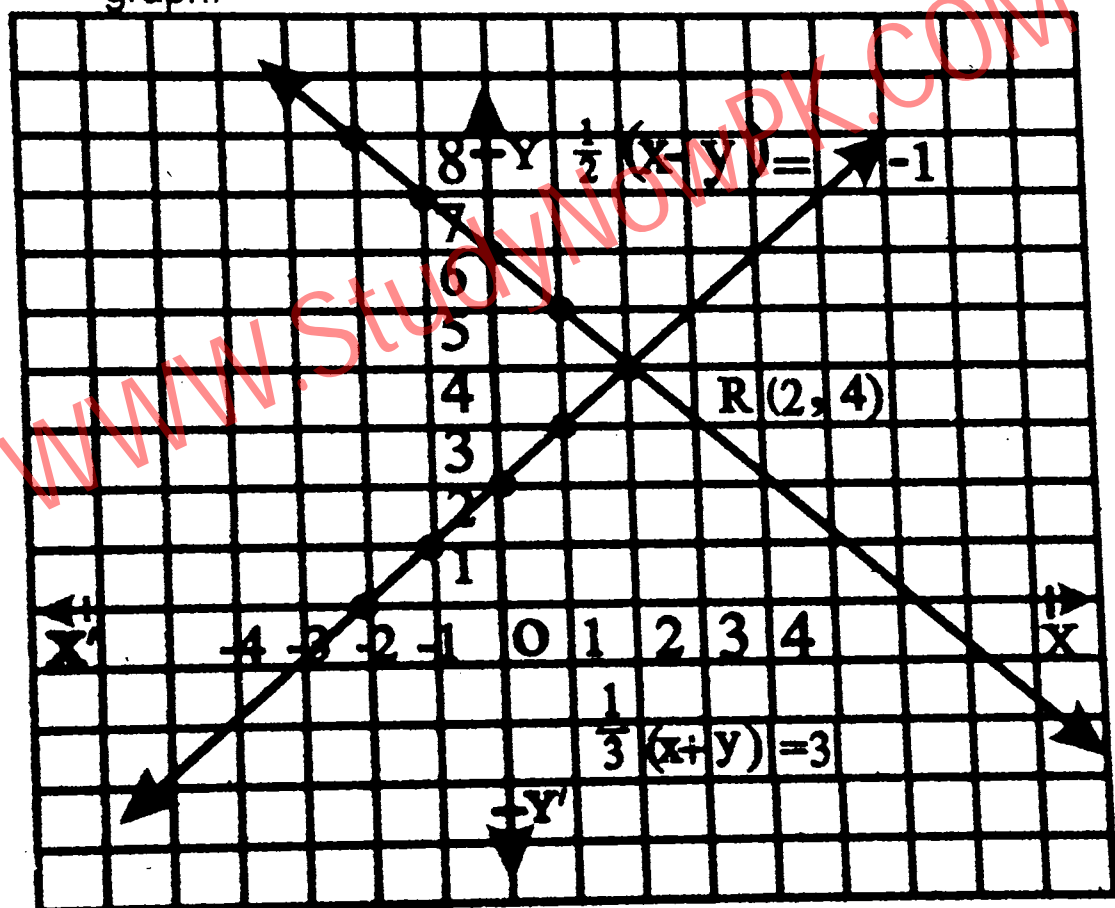
$\frac{1}{2}(x - y) = -1$ (ii)

For (i) y = 6 – x, the table of values is

x	-2	-1	0	1	2
y	8	7	6	5	4

For (ii) y = x + 2, the table of values is

x	-2	-1	0	1	2
y	0	1	2	3	4

By plotting the points of (i) and (ii) we get the following graph.

The solution set of the system is the point R.

i.e. **R(2, 4)** or x = 2, y = 4